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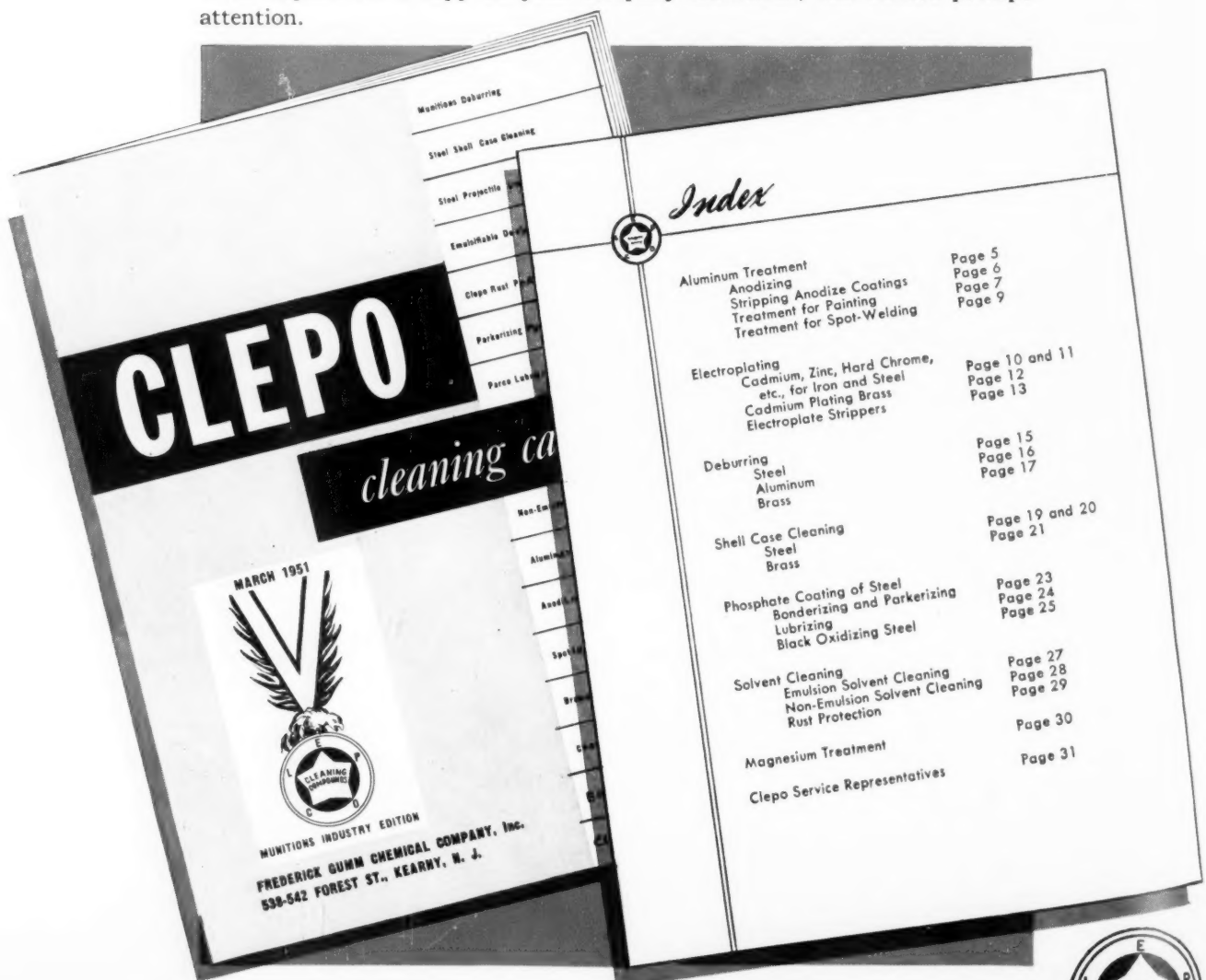
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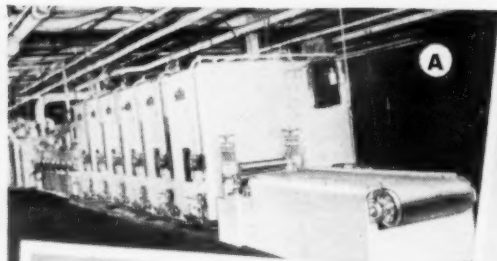
COMING SOON

The use of porous pots in nickel baths to regenerate nickel chloride and nickel sulfate from anodes.

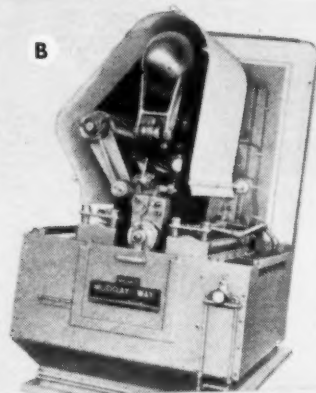
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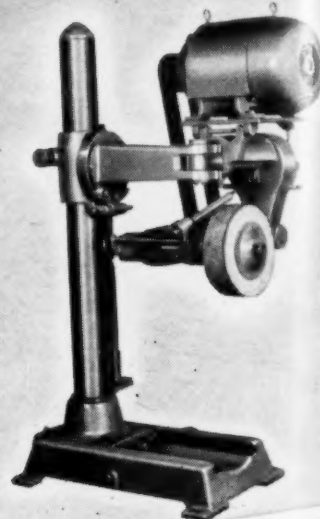
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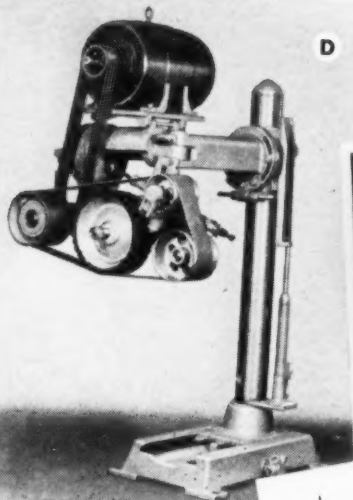
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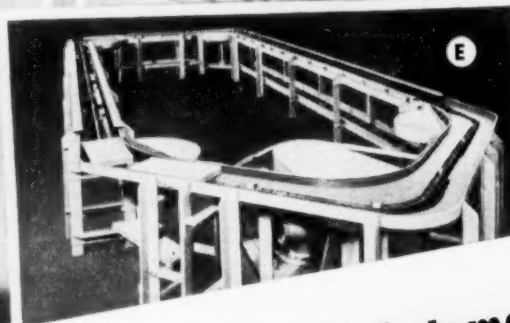
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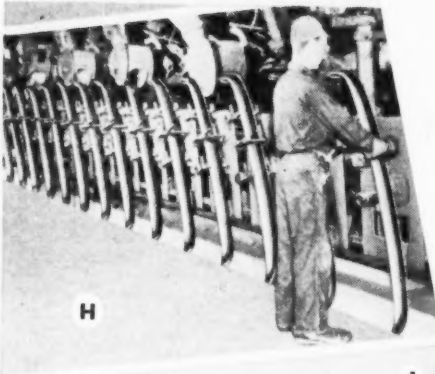
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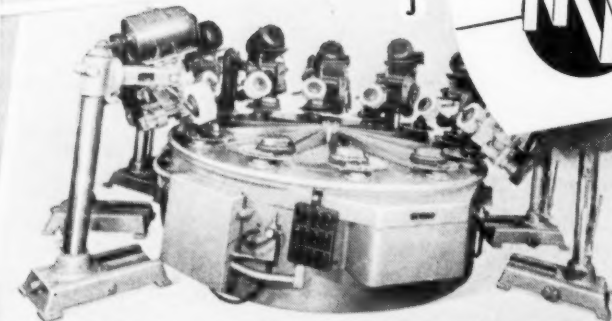
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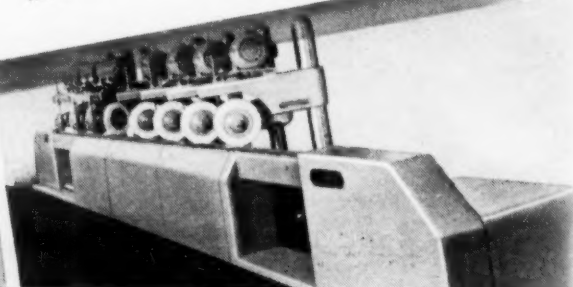
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K



The WASHINGTON OBSERVER



George W. Grupp

News and Views from The Nation's Capitol

- The Controlled Materials Plan is expected to make its bow about July first.
- Zinc controls are to be tightened to provide more of this metal for defense production.
- The NPA has asked the plumbing brass goods industry to reduce the thickness of plating wherever practicable. Further restrictions on the usage of chrome by the plumbing brass goods industry is not being considered by NPA, but it is studying the possibility of tightening its controls on the usage of nickel and zinc.
- The NPA plans to limit or prohibit the use of platinum for jewelry and other non-essential purposes. The costume jewelry industry has asked the NPA for permission to use 18% nickel-silver instead of the present 8% grade.
- Within the next three months the Government decentralization program will be under way. Thousands of employees will be moved out of Washington.
- The restrictions of Copper Order M-12 were relaxed by NPA when it issued an amendment to prevent employment dislocations, and to provide a more gradual adjustment to meet end-uses of copper (See article in this issue). NPA has also relaxed its restrictions on the usage of nickel.
- The container industry, according to NPA, will require material in 1951 for a total of 26 million hot-dip coated containers, 42 million electroplated containers, and 17 million blackplate containers.
- A bill has been introduced in Congress which will prohibit the importation of certain articles and products which contain raw materials subject to priorities and allocation under the Defense Production Act of 1950.
- Committees made up of representatives of the United States and other countries have been formed to set up machinery for the international control of such scarce commodities as cobalt, copper, lead, nickel and zinc.
- Materials for the operation, maintenance and repair of establishments producing goods and services have been assured by the NPA.
- In spite of current price controls the cost of living is expected to rise about 9 per cent before mid-summer.

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METAL FINISHING, April, 1954

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At Your Service, Uncle Sam!

In the hectic scramble to meet the demands of a stepped-up military program superimposed on a very high level of civilian production, one gets accustomed to hearing of huge industrial expansion programs and expenditures for more equipment to produce and process this output.

One of the areas of industrial production effort where extensive processing equipment expenditures should not be necessary, however, is the plating industry. The curtailment of civilian production, because of raw material shortages, has resulted in a considerable amount of idle capacity, especially in the job plating shops.

Many people, including the job platers themselves, have wondered how there can exist such a drastic reduction in the amount of work for them to do when only a comparatively small fraction of the normal civilian production seems to be affected. Actually, it is quite simple to explain. Except for certain specialty shops, or shops whose location is very favorable, job platers depend very largely on the overflow of work which manufacturers cannot handle themselves in their own plating departments. This "overflow" work makes up a major portion of the total job-plated work. A comparatively small reduction in output by the manufacturer, even as low as a 10% cut, will, however, account for the entire amount of this "overflow" volume. Thus, even though the overall production is still 90% intact, there is no work left for the job platers. This is the situation that exists in many large plating centers today.

When all it takes to keep the equipment in these shops rolling on freedom's weapons is a phone call to the local job plater's association, one of the biggest and costliest mistakes which could be made in the present preparedness program would be to overlook the ready-to-go facilities, the proven capabilities, and the "know how" of this important segment of the plating industry.

W. A. Raymond

Editor

Experiments in Chromium Plating from Non-Aqueous Media

By A. L. Hanson, D. Frokjer and D. Mitchell, Concordia College, Moorhead, Minn.

AS is well known, chromium plating is usually carried out in aqueous solutions of chromium trioxide with a small amount of sulfate added, at elevated temperatures. The present study has been made to investigate the possibilities of chromium plating from non-aqueous media. The study has been made through the sponsorship of *Research Corporation* in the form of a research grant. Immediate objectives have been to note whether chromium in valences other than VI can be used for electrodepositions and to observe whether or not a sulfate addition would be necessary. We note that qualitative studies are reported in the literature concerning the deposition of several metals from solvents such as pyridine, acetone,¹ alcohol, acetamide,² formamide,³ and others.

Procedure

A test tube of about 50 ml. capacity was used as the plating cell. The electrode assembly consisted of a platinum foil anode and removable sheet-copper cathode, each of dimensions 2 x 3 cm. The cathode was held with a platinum wire clamp in fixed position parallel to the anode. The electrodes were secured to the lower ends of an H-shaped frame of glass tubing such that they could be lowered into the plating cell and clamped into place. Electric power was supplied from a 32-volt d.c. generator and was varied by means of a rheostat to give the desired plating currents. Cell current was measured with a milliammeter. The copper cathodes were cleaned with abrasive and acid, degreased, and dried before using. The plating time was usually twenty minutes. The deposit was examined visually for appearance (color, texture, distribution) and tested for adherence either by wiping with a cloth, rubbing with powdered alumina, or scraping with a knife.

Dry chemicals used were of C. P. grade and were given no special treatment except that they were desiccated over phosphorus pentoxide. Solvents were of the highest purity obtainable and were used without further processing except that a little acetic anhydride was added to the acetic acid to render it anhydrous.



A. L. Hanson

D. Frokjer

D. Mitchell

Acetamide Solutions

A solution of .01 M CrCl_3 , in fused acetamide, was made. It was electrolyzed at 125°C. with the formation of a vertically-streaked black deposit which could be rubbed off with alumina. Upon raising the temperature to 150°C. the deposit was improved and became more adherent. With an increase of current density from 1.8 to 5.0 amps./dm.² the striations disappeared and a good, even, firm plate was obtained. It was medium gray in color. The (green) solution heated up somewhat during electrolysis, became darker, and bubbled vigorously.

The addition of a couple of drops of concentrated sulfuric acid increased the conductivity considerably, still giving a good plate; the current increased from 5 to 20 amps./dm.² as the temperature rose from 146° to 202°C. The cathode plated on both sides with a uniform, heavy, gray deposit and superficial black streaks. The plate was not readily scraped off. Again there was much bubbling and the solution changed from bright green to brown.

A .01 M solution of chromic acetate in acetamide proved inferior to the chromic chloride described above. Studies were conducted at 125° and 150°C. At the lower temperature only a brown stain formed on the cathode, with a little black streaking. Conductivity was much less than in the chloride solution; i.e., a current density of only 1.0 amp./dm.² resulted from an applied voltage of 23 volts. Adding a little sulfuric acid approximately trebled the conductivity but did not bring about satisfactory plating. When the temperature was elevated to 150°C. (sulfuric acid present) an improvement was noted. Varying the current density from 1 to 7 amps./dm.² increased the deposit somewhat. At best it was very thin after 20 min. of plating (copper showed through) but it was very adherent and of good color.

Plating of hexavalent chromium was attempted by preparing a .01 M solution of potassium dichromate in fused acetamide. At 125°C. no plating was observed. Gas was evolved and the solution became very dark. Upon adding two drops of sulfuric acid some deposit was obtained. The character of the plate improved as the temperature was raised to 150°C. and current density increased to 7 amps./dm.². The best plate was thin even after 20 minutes of plating, but was fairly bright and adherent.

Acetamide-Urea Solutions

A mixture of acetamide and urea was tried as a solvent to gain the advantage of a lower fusion temperature. It was found that a mixture of 2:1 by weight of

acetamide to urea melted at about 60°C., which represents a lowering of about 20°C. of the melting point of acetamide. There was little accomplished by electrolyzing at the lower temperature made thus available, for at 75°C. merely a dark stain appeared when a solution of .01 M chromic chloride was used. At 125°C. a streaked black deposit formed and the conductivity of the solution increased three-fold. Addition of two drops of sulfuric acid gave little more of the adherent black deposit. Upon increasing the concentration of chromic chloride to .1 M, a dense black coating formed at 75°C., with little or no gas evolution. A repeat of this determination gave again a good deposit which was dark gray rather than black. At higher temperatures the .1 M solution bubbled considerably at the electrodes and gave no plate, even with the addition of sulfuric acid. Some ammonia was evolved.

A solution of potassium dichromate in the mixed solvent gave no trace of deposit at 75°C. At 125°C. a slight black streaking developed, and more of the same formed as the sulfuric acid was added.

Formamide Solutions

The remarkably high dielectric constant of formamide (94) marks it as a dissociating solvent. It has been used quite widely in experimental study for this reason. A .01 M solution of chromic acetate at 98°C. gave a fairly even coat of dark gray metal when a current of 5 amps./dm.² was passed. The conductivity was comparatively good, since the voltage used was 17 v. Increasing the e.m.f. to 32 volts caused the current to rise to about 16 amps./dm.² as the temperature increased to 180°C. Under these conditions a plate was obtained which was about equivalent to that described above. Decreasing the current to less than one amp./dm.² at 98°C. resulted in no plate formation. A little sulfuric acid increased conductivity while giving about the same plate.

A firm deposit was obtained using chromic chloride as solute, although it tended toward streakiness and black color. The solution turned from orange to green in the process, and considerable bubbling occurred at the cathode. Some ammonia formed.

A solution .01 M in potassium dichromate gave no appreciable deposit at 98°C., using currents of 1.2 to 6.0 amps./dm.². Adding two drops of sulfuric acid trebled the current and gave a rather uniform coat of thin metal having moderate luster. It was noted that the distant side of the cathode was better plated from formamide solutions than was true in others.

Acetic Acid Solutions

Attempts were made to deposit chromium electrolytically from solutions of its salts in glacial acetic acid. Compounds used were chromic acetate, chromic chloride, and chromium trioxide. In some cases sodium acetate was added to increase conductivity. Small additions of sulfuric acid and of water were made to study their effects. From the acetate a slight deposit (black, gray, or brown) could be obtained; sodium acetate had no effect on the plate. A drop of sulfuric acid improved adherence of the deposit slightly. Chromic chloride gave only a slight deposit in black streaks. A little sulfuric acid caused a small white deposit to form.

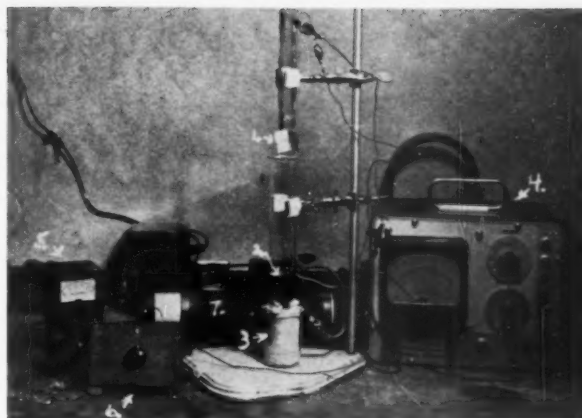


Figure 1. Experimental apparatus set-up. Electrode holder with cathode turned to show mounting. 2. Plating bath. 3. Bath heater. 4. Voltmeter for checking applied voltage. 5. Milliammeter to measure cell current. 6. Rheostat for regulating cell current. 7. Rheostat for regulating bath heater.

A trace of water provided a gray-black deposit of poor adherence. No positive results were obtained with chromium trioxide.

Ethanolamine Solutions

Dirkse and Briscoe¹ reported that ethanolamine has good possibilities as a solvent for electrodeposition. In our study, however, generally unsatisfactory results were obtained. Using chromic acetate (.01 M in the hydrated salt) a deposit was obtained which varied from thin and gray at 1.0 amp./dm.² to one more dense and black at 4.0 amps./dm.². A trace of sulfuric acid was present in the (violet) solution. Adherence improved with current rise but even the best rubbed off with alumina.

Chromic chloride gave a red to orange solution in ethanolamine. The plates obtained were quite similar to those obtained with the acetate, i.e. very thin and discolored; their adherence was somewhat better.

From potassium dichromate a very thin brown film was obtained at 125°C. Increasing the current density from 1.0 to 4.0 amps./dm.² merely caused gas evolution at the cathode. Adding a drop of concentrated sulfuric acid gave no different results; again the film wiped off readily.

Other Solvents

ACETONITRILE

Consideration was given to acetonitrile in this study because of its relatively high dielectric constant (ca. 34). Lower temperatures had to be used here than in other experiments because of the lower boiling point. Salts used were chromic acetate and chromic chloride. Plating attempts were made at 25°C. and 50°C., with and without sulfuric acid, at current densities varying from .03 to 1.0 amps./dm.². At best the deposit was merely a dark stain or mottled coating, and in most cases there was no deposit.

DIMETHYLFORMAMIDE

A sample of dimethylformamide was supplied us through courtesy of the E. I. duPont de Nemours Co., Grasselli Division. Of the various chromium compounds tried, only chromic acetate and chromic chlor-

(Concluded on page 69)

Colorimetric Determination of Metals in Industrial Wastes

By P. G. Butts and A. R. Gahler with M. G. Mellon, *Department of Chemistry, Purdue University, Lafayette, Ind.*

DISCHARGE of metallic wastes from electroplating plants and other metal-processing industries has become a matter of serious concern to public health authorities in many areas. Investigations of the various problems associated with stream pollution by metals (such as the effect on fish life, sewage digestion, and potability) have generally been handicapped by a lack of suitable analytical methods for the heavy metals involved. Most methods now recommended for water analysis are subject to serious interference by even moderate concentrations of other cations and anions, and it is not unusual to find several heavy metals present in a single sample of polluted water.

To overcome this difficulty, a program was undertaken for development of methods for cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc in sewage and industrial wastes. This paper presents colorimetric methods for each of the above metals; the methods are designed to allow the determination of as little as 0.05 mg. (0.05 p.p.m.) of the ion in question in a 1-l. sample, and are applicable in the presence of the other heavy metals listed up to at least 200 times the concentration of the desired constituent. Allowance is also made for the presence of organic matter and such anions as may commonly be found in polluted water. Detailed procedures are given for preliminary treatment of the sample, qualitative identification of the heavy metals present, and quantitative analysis by photoelectric colorimetry.

Preliminary Treatment of Samples

Samples of polluted water or sewage are evaporated and digested with acid to destroy organic matter. The procedure to be followed depends on the organic content. Digestion with a mixture of nitric and sulfuric acids serves for most samples; but when the organic matter is difficult to oxidize, perchloric acid is substituted for sulfuric acid. Perchloric acid digestion is also recommended when lead is to be determined. A special perchloric acid procedure is included for samples of unusually high organic content, such as sewage concentrates.

The amount of sample to be evaporated depends on the concentration of the metals to be determined. A 1-l. sample should be taken if analyses are to be made for

any constituents present in less than 1 p.p.m. concentration.

1. Apparatus

- 1.1 Evaporating dishes, 500-ml. capacity. Porcelain or vitreosil may be used.
- 1.2 Filtering flask.
- 1.3 Sintered glass crucibles or porcelain filter crucible and holder.

2. Reagents

- 2.1 Nitric acid, concd. Reagent grade.
- 2.2 Sulfuric acid, concd. Reagent grade.
- 2.3 Perchloric acid, 60 per cent. Reagent grade.
- 2.4 Ammonium acetate solution, 40 per cent. Dissolve 400 g. of $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ in 600 ml. of water. This solution is required only if lead is to be determined in the presence of sulfate.

3. Procedure

3.1 Digestion with nitric and sulfuric acids. Agitate the sample to obtain a homogeneous suspension of solids, measure out a suitable volume by means of a volumetric flask, and transfer to an evaporating dish. Acidify the sample with 5 ml. of HNO_3 and evaporate on a steam bath to 15 to 20 ml. An infra-red lamp placed over the sample hastens the evaporation. Transfer the solution, together with any solids remaining in the dish, to a 125-ml. conical flask; add 5 ml. additional HNO_3 and 10 ml. of H_2SO_4 , and a few glass beads or carborundum chips to prevent bumping. Evaporate on a hotplate until dense white fumes of SO_3 appear in the flask, but do not continue heating beyond this point. If the solution is not clear, add 10 ml. additional HNO_3 , and repeat the evaporation to SO_3 fumes. Cool the solution to room temperature and carefully dilute to about 50 ml. Filter through a sintered glass filter or porcelain filter crucible and wash the residue with two small portions of water. Then transfer the filtrate to a 100-ml. volumetric flask, dilute to volume with water, and mix. The resulting solution is about 3 N in acid. Aliquots of this solution are taken for the determination of metals.

If the sample contains lead, PbSO_4 will be present in the residue on the filter. In such a case, add 50 ml. of hot 40 per cent ammonium acetate to the conical flask in which the evaporation was carried out, and then draw this solution through the filter in order to dissolve the lead salts. Cool the filtrate, transfer to a 100-

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ml. volumetric flask, dilute to volume, mix, and set aside for the determination of lead.

3.2 Digestion with nitric and perchloric acids. The procedure is similar to that given for $\text{H}_2\text{SO}_4\text{-HNO}_3$ digestion, except that 10 ml. of 60 per cent HClO_4 is substituted for H_2SO_4 . After evaporating to dense fumes of HClO_4 , the solution is diluted to about 50 ml., boiled to expel chlorine, cooled, filtered, diluted to 100 ml., and mixed. The resulting solution is about 0.8 N in acid.

If the sample contains both lead and sulfate, treatment of the insoluble residue with ammonium acetate must be carried out as described in 3.1.

3.3 Digestion of sludges of high organic content. Evaporate the sample to small volume in a large evaporating dish, add 12 ml. of HNO_3 , and evaporate to near dryness. After repeating the addition of HNO_3 and evaporation once more, transfer to a 250-ml. conical flask, add 25 ml. of 1 : 1 HNO_3 and 25 ml. of 60 per cent HClO_4 and boil until nearly dry. Take up in 50 ml. of water and proceed as in 3.2.

Qualitative Tests for Metals

It is important to have available a simple qualitative test for the presence of the various metals for which quantitative methods have been developed. Spot tests and microscopic tests are ideal for this purpose. Those selected are the most satisfactory from a standpoint of specificity, sensitivity, and simplicity. They may be applied to the sample as received, but it is preferable to test the more concentrated solution obtained by the preliminary treatment of the sample. This concentrated solution is free of organic material, which might interfere with the tests. It seemed desirable to express the sensitivity of the reactions in p.p.m. rather than in the conventional terms of "limit of identification" and "limiting concentration."

Cadmium

METHOD A. SPOT TEST WITH FERROUS 2,2'-BIPYRIDINE IODIDE SOLUTION

About 1 p.p.m. cadmium can be detected in the presence of 10 p.p.m. each of Cr, Cu, Fe, Mn, Ni, Pb, and Zn.

1. Procedure

A drop of dilute HCl is added to the test solution and the solution is centrifuged to remove the precipitate of PbCl_2 . The solution is made ammoniacal and centrifuged. A drop of the supernatant liquid is placed on No. 601 S and S test paper, and a drop of reagent is added before the test drop soaks into the paper. A red fleck indicates the presence of cadmium. When cadmium is present in very low concentrations, it may be necessary to compare the spot with one formed by the reagent alone.

2. Preparation of Reagent

2,2'-bipyridine (0.25 g.) and ferrous sulfate (0.146 g. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) or ferrous ammonium sulfate (0.20 g. $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$) are dissolved in 50 ml. of water, 10 g. KI added, and, after shaking vigorously for 30 min., the $\text{Fe}(2,2'\text{-bipyridine})_3\text{I}_2$ is filtered off. The resulting saturated solution of the complex contains excess KI. If the reagent has been standing for

some time, it may be necessary to filter before use [see Feigl, "Qualitative Analysis by Spot Tests," p. 74 (1946)].

METHOD B. MICROSCOPIC TEST WITH REINECKE'S SALT AND THIUREA

A drop of a filtered 1 per cent aqueous solution of Reinecke's salt, $\text{Cr}(\text{NH}_3)_2(\text{SCN})_4\text{NH}_4$, containing 2 per cent thiourea, drawn into a drop of a neutral or slightly acidic cadmium test solution on a microscopic slide, forms a precipitate immediately, if the cadmium concentration is greater than 2.5 p.p.m. Examination of the precipitate shows that well-formed characteristic crystals develop, which are birefringent and exhibit parallel extinction. The crystals are rectangular in shape, having ends which are characteristically undeveloped.

Lower concentrations of cadmium are detected readily by concentrating about 1 ml. of the solution to 1 drop, transferring the drop to a slide with a capillary and carrying out the test as described previously. In this way, cadmium in concentrations less than 1 p.p.m. can be detected readily.

Zinc (1,000 p.p.m.) does not form crystals with the reagent. Nickel and copper (10 p.p.m.) alone with the reagent form no precipitate. The presence of nickel with cadmium causes the crystals to be tapered on both ends, the characteristic type of crystals with cadmium not being formed. The presence of copper causes rosettes to be formed. In the presence of Cr, Cu, Fe, Pb, Mn, Ni, and Zn (10 p.p.m.) rosettes are formed.

With a little practice on the part of the experimenter, this test will reveal more of the nature of the unknown solution than the spot test described for cadmium.

Chromium

About 0.3 p.p.m. of chromium may be detected in a solution containing 100 p.p.m. of Cd, Cu, Fe, Mn, Ni, Pb, and Zn.

1. Procedure

To one drop of sample on a spot plate add one drop of 20 per cent ammonium peroxydisulfate (ammonium persulfate) and one drop of 2 per cent silver nitrate. Let stand 2 to 3 minutes, then destroy any permanganate color that may have developed by adding one or two drops of 1 per cent sodium azide solution and stirring. Finally, add a drop of 1 per cent ethanolic diphenylcarbazide. A purple color, which usually fades rapidly, constitutes a positive test for chromium, while a colorless or yellow-brown solution is negative [see Feigl, "Qualitative Analysis by Spot Tests," p. 129 (1946)].

Copper

A concentration of 2 p.p.m. copper can be detected in the presence of 10 p.p.m. of Al, Ca, Cd, Fe, Ni, Mg, Mn, Pb, and Zn.

1. Procedure

Place a drop of 20 per cent malonic acid on No. 601 S and S test paper. Add four drops of the unknown (pH 3 to 7), a drop of 10 per cent ethylene diamine, and finally a drop of 1 per cent dithiooxamide reagent in 95 per cent ethanol. A green coloration indicates the

presence of copper [see West, *Ind. Eng. Chem., Anal. Ed.*, 17, 740 (1945)].

Iron

Iron (1 p.p.m.) can be detected in a solution containing 100 p.p.m. of Cd, Cr, Cu, Mn, Ni, Pb, and Zn.

1. Procedure

Place one drop of sample on a spot plate, add one drop of 10 per cent $\text{NH}_2\text{OH}\cdot\text{HCl}$ followed by one drop of 2 per cent ethanolic 1,10-phenanthroline and one drop of 20 per cent sodium acetate. Development of a pink color before or after addition of sodium acetate constitutes a positive test [see Feigl, "Qualitative Analysis by Spot Tests," p. 122 (1946)].

Lead

Approximately 0.8 p.p.m. of lead can be detected in the presence of 100 p.p.m. of Cd, Cr, Cu, Fe, Ni, Mn, or Zn.

1. Procedure

Ten drops of sample solution, one drop of 10 per cent $\text{NH}_2\text{OH}\cdot\text{HCl}$, five drops of 10 per cent sodium citrate, one drop of 6 M NH_4OH , and three drops of 5 per cent KCN are added in that order to a semi-micro test tube (8×70 mm.). Then 0.25 ml. of 0.005 per cent dithizone in CCl_4 is added and the tube is stoppered and shaken vigorously for 10 sec. An orange or pink color in the CCl_4 is a positive test, while a colorless or pale green is negative [see Feigl, "Qualitative Analysis by Spot Tests," p. 57 (1946)].

Manganese

The metal (1 p.p.m.) can be detected in the presence of 10 p.p.m. each of Cd, Cr, Cu, Fe, Pb, Ni, and Zn.

1. Procedure

A drop of solution containing the reagent is placed on No. 601 S and S test paper, then a drop of the test solution. If manganese is present, a black fleck appears. It is advisable to compare this spot with a blank.

Actually this spot test offers no advantage over the quantitative method for determining manganese. The quantitative method is quite sensitive and it takes only a few minutes to develop the permanganate color [see Feigl, "Qualitative Analysis by Spot Tests," p. 137 (1946)].

2. Preparation of Reagent

Concd. NH_4OH is added to a saturated solution of AgNO_3 until the initial precipitate is dissolved. An equal volume of NH_3 is then added.

Nickel

Nickel can be detected if present in a concentration of not less than 1 p.p.m. in a solution containing 10 p.p.m. each of Cd, Cr, Cu, Fe, Pb, Mn, and Zn. The concentration limit for nickel varies, depending on the amount of copper and manganese present.

1. Procedure

A drop of unknown solution is placed on a dry piece of No. 601 S and S test paper, which has been previously impregnated by immersion in a saturated solution of

dimethylglyoxime in acetone. The paper is then soaked in a solution of $(\text{NH}_4)_2\text{CO}_3$ for a minute or two. A red fleck appears if nickel is present [see Feigl, "Qualitative Analysis by Spot Tests," p. 116 (1946)].

Zinc

No test could be located in the literature which was sufficiently specific for zinc. The test with Cu^{++} and $\text{Hg}(\text{SCN})^-$, suggested by Feigl, was found to be insensitive in the presence of large amounts of other metals. The test given below makes use of a precipitation with NaOH to remove most of the interfering metals. About 0.8 p.p.m. Zn can be detected.

1. Procedure

To 5 ml. of sample, add 1 drop of phenolphthalein, make alkaline with 4 M NaOH, and then add 0.5 ml. in excess. Centrifuge the precipitate, or allow to settle. Place 1 drop of the supernatant liquid in an 8×70 mm. test tube and add 1 drop of a methanol solution containing 2.5 per cent CS_2 and 10 per cent diethanolamine. Then fill the test tube $\frac{1}{2}$ full of distilled water, add 1 drop of glacial acetic acid, and shake for 30 sec. with 0.25 ml. of 0.005 per cent dithizone in CCl_4 . A purple or red color in the CCl_4 constitutes a positive test for zinc.

Quantitative Methods for Selected Metals

The following procedures are based mostly upon existing methods. Literature references pertaining to the procedures are not listed because of the enormous number that would need to be included in such a bibliography. The reader is referred to books such as "Bibliography on Water and Sewage Analysis, Special Report No. 28," by Weil, Murray, Reid, and Ingols of the State Engineering Experiment Station, Georgia Institute of Technology; "Colorimetric Determination of Traces of Metals," by E. B. Sandell; "Trace Elements in Food," by Monier-Williams; and official methods proposed by many scientific organizations.

Although it would be almost impossible to check experimentally every method proposed in the literature for these metals, many were tried and their merits ascertained before accepting or rejecting any particular procedure. Admittedly, the methods can be simplified and short cuts introduced, if certain of the elements which interfere are not in the sample.

Many modifications, especially in regard to separations, were introduced by the writers to remove interferences. Some of the reagents are not yet commercially available, but have been recommended because of their desirable properties. It is believed that most of the new reagents will be available from some source in the near future.

Extractions are used primarily because of the simplicity, efficiency, and speed in separating small concentrations of constituents. Many separations can be carried out in much less time by extraction than by precipitation, volatilization, or electrodeposition.

All the methods proposed have been studied statistically to some extent with the exception of copper with 2,2'-biquinoline, in which case insufficient reagent was available. The method is included because of the specificity of the reaction of copper with 2,2'-biquinoline, combined with the reasonable good sensitivity and

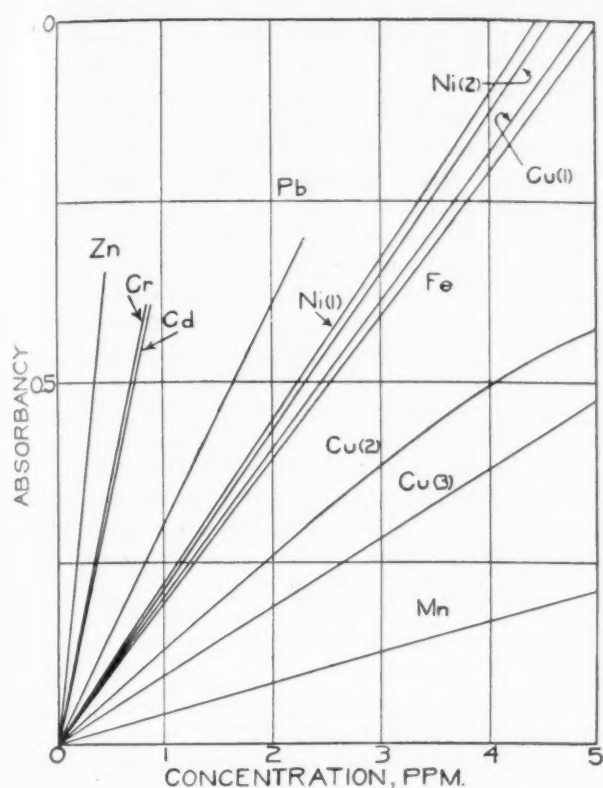


Figure 1. Comparison of the sensitivities of various colored systems. (The band width varied with the instrument. The cells were 1 cm.)

Zn—Zinc dithizonate, 535 m μ ., Beckman (DU).
 Cr—Chromium diphenylcarbazide, 540 m μ ., Beckman (DU).
 Cd—Cadmium dithizonate, 510 m μ ., Beckman (B).
 Pb—Lead dithizonate, 520 m μ ., Beckman (DU).
 Ni(1)—Nickel-1,2-cycloheptanedionedioxime, 445 m μ ., Beckman (B).
 Ni(2)—Nickel-dimethylglyoxime, 445 m μ ., Beckman (DU).
 Cu(1)—Copper-bis(2-hydroxyethyl)dithiocarbamate, 435 m μ ., Beckman (DU).
 Cu(2)—Copper-bis(2-hydroxyethyl)dithiocarbamate, blue filter, Fisher electrophotometer.
 Cu(3)—Copper-2,2'-biquinoline, 545 m μ ., Beckman (B).
 Fe—Iron-1,10-phenanthroline, 508 m μ ., Beckman (DU).
 Mn—Manganese as permanganate, 525 m μ ., Beckman (DU).

more desirable color (purple), if visual estimations of the copper concentration are to be made.

The use of pure reagents in these determinations cannot be over-emphasized. Water should be of high quality, distilled or redistilled, in order to remove traces of metals. The concentration of impurities tolerable depends on the particular determination. Water purified by ion-exchange is satisfactory in many cases, but the purity will depend on the quality of the source of water, the efficiency of the ion-exchange material, and the condition of the ion-exchange medium. Therefore, such water must be tested frequently for its purity.

Unless specified, any of the methods for digestion of organic material, as listed under the heading "Preliminary Treatment of Samples," may be used.

A comparison of the sensitivity of the various methods is shown in Figure 1. Although the absorbancy-concentration form of calibration curve was used throughout this work, other methods of plotting are usable.

Cadmium

Copper and iron are removed by extraction of the

cupferrates with CHCl_3 . Cadmium is separated from the remaining cations, including zinc, by extraction into CHCl_3 as the brucine-cadmium iodide complex. Cadmium is removed from the CHCl_3 by a dilute solution of HCl , the solution made basic with NaOH , and the cadmium extracted as the colored dithizonate with CCl_4 .

1. Apparatus

1.1. Spectrophotometer or filter photometer equipped with a filter having maximum transmittance near 510 m μ .

1.2. Separatory funnels, 125-ml. Squibb type. Amber ware is best, but not essential.

1.3. Electrodeposition apparatus for standardizing the cadmium stock solution.

1.4. Amber volumetric flasks with ground-glass stoppers are desirable, but not essential.

2. Reagents

2.1. Acetic acid, glacial.

2.2. Bromine water. Distilled water is saturated with bromine.

2.3. Brucine sulfate reagent. Dissolve 2 g. of brucine sulfate in 100 ml. of a 5 per cent solution of acetic acid. Warm to 60° to 70° C. if necessary to dissolve the crystals.

2.4. Cadmium chloride standard solution. Prepare a stock solution so that the cadmium concentration is approximately 1,000 p.p.m. Pipet 25.00 ml. of the stock solution into an electrolytic beaker and make alkaline to phenolphthalein indicator with NaOH . Add sodium or potassium cyanide (10 per cent) dropwise until the precipitate of $\text{Cd}(\text{OH})_2$ just dissolves. Dilute the solution to 100 ml. with water, and electrolyze for 30 min. at a current density of 0.6 amp. per sq. dm., then for 30 min. more at 1.2 amp. per sq. dm. Test for complete deposition by passing H_2S through a small sample of the electrolyte. If a yellow precipitate or color forms, continue the electrolysis until no cadmium remains in solution. Wash the plated platinum cathode in ethanol, dry at 110°C. for 3 to 5 min., cool, and weigh. Dissolve the cadmium in H_2SO_4 (1:1), wash the electrode, dry, and weigh as before. The difference in weight is the amount of cadmium present in the aliquot taken. If $\text{Cd}(\text{NO}_3)_2$ is used instead of CdCl_2 , the sample taken for electrolysis must be fumed with H_2SO_4 to remove the nitrate.

2.5. Carbon tetrachloride, c.p. If the CCl_4 is not c.p., it must be redistilled. Pure CCl_4 may be obtained by refluxing the impure material with 5 per cent NaOH for 2 hr., separating the CCl_4 from the NaOH , washing the CCl_4 with water, drying over CaCl_2 , and then distilling over CaO .

2.6. Chloroform, c.p.

2.7. Cotton. Metal-free absorbent cotton is prepared by digesting the cotton for several hours with warm 0.2N HCl . The cotton is filtered on a Büchner funnel, washed with large volumes of distilled water to remove the acid completely, and dried.

2.8. Cupferron reagent, aqueous 1 per cent (ammonium salt of nitrosophenylhydroxylamine). Store in refrigerator or make up fresh for each determination.

2.9. Dithizone solution, 20 mg. dithizone per 100 ml. of CCl_4 . Dissolve 0.100 g. of diphenylthiocarbazone

in 500 ml. of pure CCl_4 . Store in a dark bottle in a cool place, preferably in a refrigerator.

2.10. Dithizone solution, 10 mg. dithizone per 100 ml. of CCl_4 . Purify the solution containing 20 mg. dithizone in 100 ml. of CCl_4 just before use as follows: Measure 75 ml. of the dithizone solution into a 250-ml. separatory funnel, add 75 ml. of distilled water, and then 8 ml. of 6 M NH_4OH . Shake well, discard the CCl_4 layer, and shake with portions of fresh CCl_4 until the CCl_4 layer becomes colorless. Add 75 ml. of pure CCl_4 , make acidic with 6 M HCl and shake. Draw off the CCl_4 layer, wash with a 100-ml. portion of distilled water, and dilute the CCl_4 to 150 ml. The solution should be repurified if allowed to stand more than one-half day.

2.11. Hydrochloric acid, c.p., 0.5 M.

2.12. Hydroxylamine hydrochloride solution. Dissolve 10 g. of $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 90 ml. of distilled water.

2.13. Methyl red indicator. A 0.1 per cent solution in 95 per cent ethanol.

2.14. Potassium iodide, c.p. Dissolve 10 g. of KI in 90 ml. of water.

2.15. Sodium citrate, c.p. Dissolve 10 g. of $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7\cdot 2\text{H}_2\text{O}$ in 90 ml. of water.

2.16. Sodium hydroxide, c.p. Dissolve 20 g. of NaOH in 80 ml. of water.

2.17. Water. Redistilled water free from all metals is essential for preparation of reagent solutions.

3. Preparation of Calibration Curve

Prepare a dilute cadmium solution from the stock solution so that the cadmium concentration is about 2.5 p.p.m. Pipet suitable volumes of this solution into 125-ml. separatory funnels so that from 3 to 17.5 micrograms of cadmium are present in the samples. Carry through the operations as described under 4. The absorbancy-concentration calibration curve should be a straight line for this range of concentration.

4. Procedure

4.1. Separation of copper and iron. After removing the organic material in the original sample by digestion with H_2SO_4 and HNO_3 acids (see "Preliminary Treatment of Samples, 3.1") take an aliquot containing from 3 to 17.5 micrograms of cadmium, place in a separatory funnel, add 10 ml. of sodium citrate, one drop of methyl red indicator, and enough dilute NaOH to make the solution just basic to the indicator. Add 2 to 3 ml. of glacial acetic acid to adjust the pH to 3.0 to 3.8. Cool the solution by running cold tap water over the separatory funnel. Add 4 ml. of cold, fresh cupferron reagent and shake the solution with 10 ml. of CHCl_3 . Allow the layers to separate, and add more cupferron until a white silky precipitate forms, which indicates that an excess of cupferron is present. Shake the mixture, allow the layers to separate, and discard the CHCl_3 layer. Repeat with a fresh 10-ml. portion of CHCl_3 . Add 1 ml. of bromine water, mix, let stand 1 min., extract excess bromine water with 5 ml. of CHCl_3 , and then add 1 ml. of $\text{NH}_2\text{OH}\cdot\text{HCl}$ solution.

4.2. Separation of cadmium from chromium, lead, nickel, manganese, and zinc. Five ml. of KI solution and 5 ml. of brucine sulfate reagent are added to the solution from 4.1. Extract three times with 15-ml. portions of CHCl_3 and collect the CHCl_3 layers in another 125-ml. separatory funnel. (This separatory funnel

should have been cleaned thoroughly to remove metal ions by shaking in the funnel about 10 ml. of dithizone solution with some pure water to which a few drops of dilute NaOH have been added, and finally rinsing with redistilled water.) Re-extract the cadmium into the aqueous phase with 20 ml. of HCl . Allow the phases to separate. Transfer the CHCl_3 layer to another clean separatory funnel and wash with 10 ml. of HCl . Discard the CHCl_3 layer. Add the wash solution to the other solution containing cadmium. Rinse the stopper and funnel with about 10 ml. of distilled water, and add it to the cadmium solution. After the addition of 30 ml. of NaOH to the cadmium solution, cool the solution to room temperature. Extract the cadmium with one 10-ml. portion of recently purified dithizone in CCl_4 (10 mg. dithizone in 100 ml. of CCl_4). Allow the layers to stand at least 1 min. before drawing off the CCl_4 . Pass the CCl_4 through a small pledget of cotton in a short-stem funnel placed in a dry 25-ml. volumetric flask. Repeat the extraction with two 5-ml. portions of dithizone and one 4-ml. portion of fresh CCl_4 . Dilute to volume with fresh CCl_4 , mix, and measure the absorbancy of the solution at 510 m μ in a 1-cm. cell using CCl_4 in the reference cell.

During the extraction of the cadmium with dithizone it is advisable to darken the room, if amber glassware is not used. A towel may be wrapped around the volumetric flasks to prevent sunlight from affecting the light-sensitive solution. A blank is not necessary if the dithizone solution has been recently purified.

Chromium

Total chromium is determined colorimetrically with diphenylcarbazide after oxidation in acidic solution with ammonium peroxydisulfate. Interference from iron is eliminated by means of a preliminary separation with cupferron. Manganese, if present, is oxidized to permanganate, but the resulting color can be discharged with sodium nitrite without reduction of chromium.

1. Apparatus

1.1. Photoelectric filter photometer with green filter (ca. 540 m μ), or photoelectric spectrophotometer.

2. Reagents

2.1. Acetic acid, glacial.

2.2. Ammonium peroxydisulfate (ammonium persulfate) solution. Dissolve 20 g. $(\text{NH}_4)_2\text{S}_2\text{O}_8$ in 80 ml. of water. Prepare fresh every few days.

2.3. Ammonium sulfamate solution. Dissolve 5 g. $\text{NH}_4\text{SO}_3\text{NH}_2$ in 95 ml. of water.

2.4. Cupferron reagent. Dissolve 1 g. of the analytical reagent in 100 ml. of water. Keep in a cool place and prepare fresh every three or four days.

2.5. Diphenylcarbazide reagent. Dissolve 0.125 g. of diphenylcarbazide (Eastman) in 50 ml. of 95 per cent ethanol. Keep in a cool place and discard when the reagent turns brown.

2.6. Mixed acid. 3 N H_2SO_4 + 1.5 N H_3PO_4 . Mix 83 ml. of concd. H_2SO_4 and 100 ml. of 85 per cent H_3PO_4 with water and dilute to 1 l. Add 0.01 N KMnO_4 solution dropwise to the hot acid until a faint pink color appears.

2.7. Potassium dichromate, 0.200 mg. chromium per ml. Dissolve 0.565 g. of dried $K_2Cr_2O_7$ in water and dilute to 1,000 ml.

2.8. Potassium dichromate, 0.00800 mg. chromium per ml. Prepare shortly before use by diluting 10.00 ml. of solution 2.7 to 250 ml.

2.9. Silver nitrate, 0.001 M. Dissolve 0.170 g. $AgNO_3$ in 1 l. of water.

2.10. Sodium nitrite solution. Dissolve 5 g. $NaNO_2$ in 95 ml. of water.

3. Preparation of Calibration Curve

Pipet 2.00, 5.00, 10.00, 12.00, and 15.00-ml. portions of the standard dichromate solution containing 0.008 mg. chromium per ml. into separate 100-ml. volumetric flasks and dilute to 60 ml. Add 10 ml. of mixed acid solution, then add from a pipet 2.0 ml. of diphenylcarbazide while swirling the flask. Dilute, mix, and measure the absorbancy at 540 m μ within 5 min. Plot an absorbancy, concentration curve. The color fades rapidly after 10 to 15 min., and the calibration curve is not linear at higher concentrations.

4. Procedure

4.1. Dilute an aliquot of the sample (see "Preliminary Treatment of Samples, 3.1") containing at least 10 micrograms of chromium to about 50 ml. and add 10 ml. of mixed acid solution. Slowly add sufficient cupferron to precipitate iron (note 1). Filter through a sintered glass filter and wash with cold water.

Transfer the filtrate to a 250-ml. conical flask, add 1 ml. of $AgNO_3$, 5 ml. of $(NH_4)_2S_2O_8$, a few glass beads, and heat to boiling. After boiling for 6 or 7 min., the brown turbidity resulting from partial oxidation of excess cupferron should disappear and leave a clear solution; if it does not, add an additional 5 ml. of $(NH_4)_2S_2O_8$ (note 2). Continue boiling for at least 20 min. after the last addition of $(NH_4)_2S_2O_8$ to insure complete decomposition of the excess oxidant, then cool the solution to room temperature. If the solution is colored by permanganate, reduce the MnO_4^- by carefully adding $NaNO_2$ solution one drop at a time, swirling for about 15 sec. between each drop; avoid any large excess of nitrite. Finally, add 2 ml. of ammonium sulfamate and allow to stand for 15 min. If manganese is absent, use of $NaNO_2$ and ammonium sulfamate is omitted.

Transfer the solution to a 100-ml. volumetric flask. If the chromium content exceeds 0.12 mg. (note 3), dilute to volume, mix, transfer an aliquot containing less than 0.12 mg. to a second 100-ml. volumetric flask, and add sufficient mixed acid solution to make the final H_2SO_4 concentration 0.3 N; if less than 0.12 mg. of chromium is present, the color is developed in the flask without further addition of acid. Develop the color by bringing the volume to about 70 ml. and adding 2.0 ml. of diphenylcarbazide while swirling the flask. Dilute to volume, mix, and measure the absorbancy at 540 m μ within 5 min.

4.2. Notes. 4.2.1. About 1 ml. of cupferron should be used for each milligram of iron present, but at least 3 ml. should be added in any case. It is also possible to precipitate the cupferrates in a 125-ml. separatory funnel and extract them by shaking with 20 ml. of $CHCl_3$.

4.2.2. If the manganese content of the sample aliquot exceeds 1 mg., some MnO_2 may be formed during the oxidation and the solution then does not clear completely. The MnO_2 can be reduced in the same manner as MnO_4^- .

4.2.3. A concentration of 0.12 mg. of chromium is approximately the limit for visual detection of the yellow dichromate color in 50 ml. of solution.

Copper

METHOD A. WITH BIS(2-HYDROXYETHYL) DITHIOCARBAMATE

Copper is separated from other metals by $CHCl_3$ extraction of its salicylaldoxime complex from acetic acid solution. The isolated copper is then determined colorimetrically using bis(2-hydroxyethyl) dithiocarbamate, which forms a yellow-brown water-soluble complex with cupric ion. The color is stable for about 1 hr. in solutions buffered within pH range of 3 to 6.

1. Apparatus

1.1. Photoelectric filter photometer with blue filter (ca. 435 m μ), or photoelectric spectrophotometer.

1.2. Separatory funnels, 125-ml. Squibb form with ground-glass stoppers.

2. Reagents

2.1. Acetic acid, glacial.

2.2. Ammonium hydroxide, 5 M. Dilute 333 ml. concd. NH_4OH to 1,000 ml.

2.3. Bis(2-hydroxyethyl) dithiocarbamate reagent. Solution A: Dissolve 4.0 g. of diethanolamine in 200 ml. of methanol. Solution B: Dissolve 1.00 ml. of CS_2 in 200 ml. of methanol. The colorimetric reagent is prepared fresh each day by mixing equal volumes of solutions A and B.

Impurities in the diethanolamine, methanol, or CS_2 cause the colored system to be instable. Therefore, purification of these chemicals may be necessary before preparation of the reagents.

2.4. Chloroform, c.p.

2.5. Copper-free distilled water for the preparation of reagents and dilution water.

2.6. Copper standard solution. Dissolve 1.000 g. of pure copper in 10 ml. of 1:1 HNO_3 . Dilute, boil to expel oxides of nitrogen, and dilute to 1,000 ml. One ml. contains 1 mg. of Cu.

2.7. Hydroxylamine hydrochloride. Dissolve 10 g. of $NH_2OH \cdot HCl$ in 90 ml. of water.

2.8. Nitric acid, 1 M. Dilute 43.5 ml. concd. HNO_3 to 1,000 ml.

2.9. Salicylaldoxime solution. Dissolve 1 g. of salicylaldoxime (Eastman) in 5 ml. of 95 per cent ethanol and pour into 95 ml. of water heated to 80°C.

2.10. Sodium acetate. Dissolve 200 g. $NaC_2H_3O_2 \cdot 3H_2O$ in 800 ml. of water.

3. Preparation of Calibration Curves

3.1. Range 0 to 0.16 mg. copper per 100 ml. Dilute 2.00 ml. of standard copper solution to 100 ml. Pipet 2.00, 4.00, 6.00, and 8.00-ml. portions of this solution into 100-ml. volumetric flasks, add 10 ml. of HNO_3 and 10 ml. of sodium acetate to each, then dilute to about 50 ml. and add 1 ml. of mixed bis(2-hydroxyethyl)

dithiocarbamate reagent. Dilute to volume, mix, and determine the absorbancy of these solutions at 435 m μ in a 5-cm. absorption cell. Use a blank containing all reagents except the copper solution in making the zero setting. Plot an absorbancy-concentration curve. The calibration curve is not linear unless a narrow spectral band is used.

3.2. Range 0 to 0.50 mg. copper per 100 ml. Dilute 5.00 ml. of standard copper solution to 100 ml. Pipet 2.00, 5.00, 7.00, and 10.00-ml. portions of this solution into 100-ml. volumetric flasks and proceed as in 3.1. The absorbancy of each solution is measured in a 1-cm. cell.

4. Procedure

4.1. Pipet an aliquot of the sample containing at least 10 micrograms of copper into a 125-ml. separatory funnel, and bring the volume to 20 to 25 ml. Add 5 ml. of NH_2OH , a drop of methyl orange, and NH_4OH dropwise with swirling until the color of the indicator just changes to orange. Acidify with 2.0 ml. of glacial acetic acid and add 5 ml. of salicylaldoxime reagent. After 1 or 2 min. extract with 25 ml. of CHCl_3 , shaking for about 30 sec. Draw off the CHCl_3 layer into a second separatory funnel, add 2 ml. more salicylaldoxime reagent to the aqueous solution, and repeat the extraction with 10 ml. of CHCl_3 . Add the second CHCl_3 extract to the first and discard the aqueous solution.

Shake the combined CHCl_3 extracts with 15 ml. of HNO_3 to remove the copper. Separate the CHCl_3 phase, and transfer the acidic solution to a 100-ml. volumetric flask (note 1). Extract the CHCl_3 once more with 10 ml. of HNO_3 , discard the CHCl_3 , and add the second acid extract to the first.

If the amount of copper in the original aliquot exceeds 0.5 mg., the solution is diluted to 100 ml., mixed, and an aliquot taken for the colorimetric measurement (note 2); otherwise, the color is developed in the original flask. Add 1 ml. of mixed bis(2-hydroxyethyl) dithiocarbamate reagent to the solution, which has been diluted to about 50 ml. Then add immediately sufficient sodium acetate to bring the pH to 4 to 5; the amount required is 25 ml. unless an aliquot of the solution was taken, in which case a corresponding fraction of 25 ml. is used. Add 1 ml. additional bis(2-hydroxyethyl) dithiocarbamate reagent, dilute to volume, mix, and measure the absorbancy of the solution. A blank should be carried through the procedure and used to obtain the zero setting of the photoelectric instrument.

4.2. Notes.

4.2.1. For very small amounts of copper (0.05 mg. or less) it is preferable to make to a volume of 50 ml. rather than 100 ml. for colorimetric measurement. In this case, two 10-ml. portions of HNO_3 are used to extract copper from the CHCl_3 , and the solution is buffered with 20 ml. of sodium acetate.

4.2.2. If a yellow-green color is easily visible in the CHCl_3 , the copper content exceeds 0.5 mg. and an aliquot should be taken.

METHOD B. WITH 2,2'-BIQUINOLINE

Copper may be determined directly upon the prepared solution without separating colored ions, such as chromium, iron, and nickel, unless these metals are present in concentrations greater than 15, 100, and

100 p.p.m., respectively, in the final copper solution. If necessary, the copper may be separated from the colored ions with salicylaldoxime as described in Method A.

1. Apparatus

1.1. Spectrophotometer or filter photometer equipped with a filter having a maximum transmitter near 545 m μ .

2. Reagents

2.1. Acetic acid, glacial.

2.2. 2,2'-biquinoline reagent. Dissolve 0.05 g. of the solid in 100 ml. of glacial acetic acid.

2.3. Copper standard solution. Dissolve 1.000 g. of pure copper in 10 ml. of 1:1 HNO_3 . Dilute, boil to expel oxides of nitrogen, and dilute to 1,000 ml. One ml. contains 1 mg. of Cu.

2.4. Hydroxylamine hydrochloride. Dissolve 10 g. of $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 90 ml. of water.

2.5. Malonic acid. Dissolve 20 g. of $\text{CH}_2(\text{CO}_2\text{H})_2$ in 80 ml. of water.

2.6. Sodium acetate. Dissolve 20 g. of $\text{NaC}_2\text{H}_3\text{O}_2\cdot 3\text{H}_2\text{O}$ in 80 ml. of water.

2.7. Water, copper-free for solution preparation and for dilution.

3. Preparation of Calibration Curve

3.1. Treatment. Pipet aliquots of a standard copper solution into 100-ml. volumetric flasks. The series should cover from 0.05 to 0.6 mg. of copper, if 1-cm. cells are used. Add 5 ml. of NH_2OH , 20 ml. of glacial acetic acid, 15 ml. of sodium acetate, 5 ml. of malonic acid, 20 ml. of the 2,2'-biquinoline reagent, dilute to 100 ml., and mix. The pH should be about 2.0. If more dilute copper solutions are to be measured, 5-cm. cells can be used.

3.2. Measurement. The solutions are measured at the analyst's convenience at 545 m μ . The reference cell contains a blank containing all the reagents except copper. Prepare an absorbancy-concentration calibration curve from the data obtained.

4. Procedure

4.1. Method I: Amount of chromium, iron, and nickel is less than 1.5, 10, and 10 mg., respectively, in the aliquot. Pipet an aliquot of the sample containing 0.05 to 0.6 mg. of copper into a 100-ml. volumetric flask (see "Preliminary Treatment of Samples, 3.1"). Add dilute NaOH until the metals present begin to precipitate or until the solution is about pH 3 to 4. Proceed as described in 3.1 and 3.2.

4.2. Method II: Amount of chromium, iron, and nickel is greater than 1.5, 10, and 10 mg. respectively, in the aliquot. Pipet an aliquot of the sample containing from 0.05 to 0.6 mg. of copper into a 125-ml. separatory funnel and dilute to a volume of 20 to 25 ml. Proceed with the separation of the copper from the other metals by salicylaldoxime, exactly as described under Procedure 4.1 in Method A. The HNO_3 solution containing the copper is then treated with 2,2'-biquinoline as described under 3.1 and 3.2 (Method B) without neutralizing the HNO_3 solution with dilute NaOH.

Iron

Iron is separated from interfering materials by extraction with diisopropyl ether from hydrochloric acid solution. The colorimetric determination is made using 1,10-phenanthroline in acetate buffered solution. The color is stable indefinitely.

1. Apparatus

1.1. Photoelectric filter photometer with green filter (ca. 508 mμ), or photoelectric spectrophotometer.

1.2. Separatory funnels, 125-ml. Squibb form with ground-glass stoppers.

2. Reagents

2.1. Diisopropyl ether.

2.2. Hydrochloric acid. Concd., free from iron.

2.3. Hydroxylamine hydrochloride. Dissolve 10 g. $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 90 ml. of water. Prepare fresh every few days.

2.4. Iron-free distilled water for the preparation of reagents and for dilution water.

2.5. Iron standard solution, 1 mg. iron per ml. Dissolve 0.1000 g. pure iron wire in 10 ml. of 1:1 HCl and dilute to 100 ml.

2.6. Iron standard solution, 0.020 mg. iron per ml. Prepare shortly before use by diluting 10 ml. of the above solution to 500 ml.

2.7. 1,10-phenanthroline solution. Dissolve 0.5 g. of the monohydrate in 500 ml. of water heated to 80° to 90°C.

2.8. Sodium acetate solution. Dissolve 200 g. $\text{NaC}_2\text{H}_3\text{O}_2\cdot 3\text{H}_2\text{O}$ in 800 ml. of water.

3. Preparation of Calibration Curves

3.1. Range 0 to 0.10 mg. iron per 100 ml. Pipet 1.00, 2.00, 3.00, 4.00, and 5.00-ml. portions of the standard iron solution (0.020 mg. per ml.) into 100-ml. volumetric flasks, and add 1 ml. of NH_2OH and 1 ml. of sodium acetate to each. Dilute to about 75 ml. and add 10 ml. of 1,10-phenanthroline. Dilute to volume, mix, and determine the absorbancy at 508 mμ after 10 min. in a 5-cm. cell. Use a blank containing all reagents except the standard iron solution to obtain the zero setting of the instrument. Plot an absorbancy-concentration curve. The color system obeys the Beer-Bouguer law.

3.2. Range 0 to 0.50 mg. iron per 100 ml. The procedure is identical to that given in 3.1. except that 5.00, 10.00, 15.00, 20.00, and 25.00-ml. aliquots of the standard iron solution are taken, and absorbancy measurements are made in 1-cm. cells.

4. Procedure

4.1. Transfer a 10.00-ml. aliquot of the sample to a 125-ml. separatory funnel and add 16.0 ml. of concd. HCl. Cool the solution, and then extract the iron with 25 ml. of diisopropyl ether, shaking for 30 sec. Draw off the lower acid layer into a second separatory funnel, and extract twice more with 10-ml. portions of ether. Combine the ether extracts in the original funnel and discard the acid layer.

Shake the combined ether extracts with 25 ml. of water to return the iron to the aqueous phase, and transfer the lower water layer to a 100-ml. volumetric flask. Repeat the extraction with a 10-ml. portion of

water, adding this to the first aqueous extract. Discard the ether layer.

To the combined water extracts add 1 ml. of NH_2OH and 10 ml. of sodium acetate, and then complete the determination as described in 3.1. A blank should be carried through the procedure and used to obtain the zero setting of the instrument.

4.2. Notes.

4.2.1. If the iron content of the 10-ml. sample exceeds 0.5 mg., the aqueous extract from the ether separation is diluted to 100-ml. and an aliquot transferred to another 100-ml. volumetric flask for color development.

4.2.2. Failure to decolorize the HCl solution with three ether extractions should not be taken as evidence of incomplete extraction of iron. Copper, which is not extracted, gives a similar yellow color.

Lead

Lead is separated from other common metals by extracting with diphenylthiocarbazone from potassium cyanide solution. Only bismuth and thallium, both uncommon metals, react similarly. The carbon tetrachloride solution containing the lead dithizonate is washed with fresh cyanide solution to remove excess dithizone, after which the lead is determined by measurement of the red color of lead dithizonate. Iron and other substances which oxidize dithizone in basic solution are rendered harmless by preliminary reduction with hydroxylamine hydrochloride.

When the original sample contains sulfate, it is necessary to make an additional determination of lead in the insoluble residue from the acid digestion. This is accomplished by extracting the residue with ammonium acetate and determining the lead in this extract with dithizone.

1. Apparatus

1.1. Photoelectric filter photometer with green filter (ca. 520 mμ), or photoelectric spectrophotometer.

1.2. Separatory funnels, 125-ml. Squibb form with ground-glass stoppers.

2. Reagents

2.1. Ammonium hydroxide, lead-free.

2.2. Carbon tetrachloride, c.p.

2.3. Dithizone solution, 0.01 per cent in CCl_4 . Dissolve 50 mg. of diphenylthiocarbazone in 500 ml. of pure CCl_4 . Keep in the dark in a cool place.

2.4. Dithizone solution, 0.005 per cent in CCl_4 . Prepare a purified solution as follows: Measure 125 ml. of 0.01 per cent dithizone into a 500-ml. separatory funnel and add 100 ml. of water, then 3 ml. of 5 M NH_4OH . Shake well and discard the CCl_4 layer. Add 125 ml. of pure CCl_4 , then make just acidic with 6 M HCl and shake. Draw off the CCl_4 layer, wash it twice by shaking with 50-ml. portions of distilled water, and then dilute to 250 ml. with pure CCl_4 . Keep in a cool, dark place and do not use if more than one week old.

2.5. Hydroxylamine hydrochloride. Dissolve 10 g. of $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 90 ml. of water.

2.6. Lead-free distilled water for preparation of reagents and dilution water.

2.7. Lead standard solution, 1.000-mg. of lead per ml. Dissolve in water 1.600 g. of pure $\text{Pb}(\text{NO}_3)_2$ which

has been dried at 110°, add 5 ml. of concd. HNO₃, and dilute to 1,000 ml. in a volumetric flask.

2.8. Potassium cyanide, 5 per cent. Prepare a lead-free solution as follows: Dissolve 25 g. of KCN in 50 ml. of water and shake with successive small portions of 0.01 per cent dithizone in CHCl₃ until the last portion is green. Then extract with five 20-ml. portions of fresh CHCl₃ to remove most of the dithizone from the aqueous solution. The small amount remaining after this treatment is not detrimental. Dilute the cyanide solution to 500 ml.

2.9. Potassium cyanide, 0.5 per cent. Dilute 10 ml. of the purified 5 per cent KCN solution to 100 ml.

2.10. Sodium citrate solution. Dissolve 10 g. of Na₃C₆H₅O₇·2H₂O in 90 ml. of water. Shake with 10 ml. of 0.01 per cent dithizone in CHCl₃ to remove lead, then filter.

3. Preparation of Calibration Curve

Prepare shortly before use a dilute lead solution containing 0.005 mg. of lead per ml. by diluting 5.00 ml. of the standard lead solution to 1,000 ml. Pipet 5.00, 10.00, 15.00, and 20.00-ml. portions of this solution into separate 125-ml. separatory funnels and adjust the volume of each to about 25 ml. A blank containing 25 ml. of water is also carried through. Add to each funnel 2 ml. of sodium citrate and 10.0 ml. of potassium cyanide, and then extract with 10 ml. of 0.005 per cent dithizone, shaking for 30 sec. Draw off the CCl₄ layer into another separatory funnel and repeat the extraction with successive 5-ml. portions of dithizone until the last portion shows no pink color; it should be colorless or pale green.

Wash the combined CCl₄ extracts with one 10-ml. portion of potassium cyanide, shaking for 15 sec., and discard the aqueous layer. Wash twice with 10-ml. portions of distilled water. Finally, transfer the pink CCl₄ solution to a dry 50-ml. volumetric flask; use a few milliliters of fresh CCl₄ to rinse the last drops of CCl₄ solution from the separatory funnel.

Dilute the solutions to 50.0 ml. with pure CCl₄, mix, and determine their absorbancy at 520 mμ within 30 min., using a 1-cm. absorption cell. Plot an absorbancy-concentration curve. The calibration curve should be linear.

Difficulty is sometimes encountered in extracting larger amounts of lead, due to the low solubility of lead dithizonate in CCl₄; this may cause red flecks of the complex to separate at the solvent-water interface. If necessary, this precipitate may be dissolved by persistent shaking with a few milliliters of fresh CCl₄ and added to the combined CCl₄ extracts.

4. Procedure

4.1. Transfer an aliquot of the sample (see "Preliminary Treatment of Samples, 3.1") containing between 10 and 100 micrograms of lead to a 100-ml. beaker and adjust the volume to 15 to 20 ml. Add 2 ml. of NH₂OH and 2 ml. of sodium citrate. Drop in a piece of red litmus paper and add NH₄OH dropwise with stirring until the solution is just basic to litmus. Then add 10.0 ml. of KCN, cover with a watch glass, and heat to boiling. Cool, and transfer the solution to a 125-ml. separatory funnel, using a minimum amount of

water to rinse the beaker. Extract the lead with 0.005 per cent dithizone in CCl₄ and complete the determination exactly as described in 3 (above).

4.2. When the original sample contains both lead and sulfate, additional lead may be found in the ammonium acetate washings; this lead is to be determined and added to that found above. Transfer an aliquot of the ammonium acetate extract containing not more than 100 micrograms of lead to a 125-ml. separatory funnel, dilute to 25 ml. and add 10.0 ml. of KCN. A blank containing ammonium acetate and 10.0 ml. of KCN is prepared similarly. Extract the lead with dithizone and complete the determination as described above.

Manganese

Manganese is readily determined in small concentrations by the colorimetric determination of permanganate formed by oxidation of the manganese with periodate in acidic solution.

1. Apparatus

1.1. Spectrophotometer or filter photometer with a green filter having a maximum transmittance near 525 mμ.

2. Reagents

2.1. Manganese (II) sulfate solution, 1,000 p.p.m. Mn. Dissolve 16 g. of KMnO₄ (c.p. grade) in distilled water, allow to stand several hours at 70° to 80°C., filter through a glass or asbestos-mat filter crucible, dilute to 500 ml., and standardize titrimetrically with sodium oxalate.* Calculate the volume of this solution necessary to prepare 1 l. of a solution containing 1,000 p.p.m. in manganese as follows:

$$\text{Vol. KMnO}_4 = \frac{910}{N \text{ KMnO}_4}$$

To this volume add 5 ml. of concentrated H₂SO₄, then NaHSO₃ solution (30 per cent) dropwise until the permanganate color disappears. Boil off the excess SO₂, cool, dilute to 1 l. with distilled water.

2.2. Nitric acid, 1:1.

2.3. Phosphoric acid, 6 M.

2.4. Potassium periodate, solid.

2.5. Sodium nitrite solution, 5 per cent. Dissolve 5 g. of c.p. salt in 95 ml. of water.

2.6. Sulfuric acid, concd.

3. Preparation of Calibration Curve

3.1. Treatment. Aliquots containing from 0 to 2.0 mg. of manganese (if absorbancy is measured in 1-cm. cells) or 0 to 0.5 mg. (with 5-cm. cells) are placed in 250-ml. conical flasks. To the solutions are added 25 ml. of water, 1 ml. of concd. H₂SO₄, 1.0 ml. of HNO₃, 20 ml. of H₃PO₄, and 0.3 g. of solid KIO₄. Heat the solution just below boiling for 10 min., cool, dilute to 100 ml. in a volumetric flask, and mix.

3.2. Measurement. The absorbancy (or transmit-

*Fowler, R. H., and Bright, H. A., "Standardization of Permanganate Solutions with Sodium Oxalate," *Jour. Res. Natl. Bur. Standards*, **15**, 493 (1935).

tancy) of the colored solution is measured at 525 m μ . A green filter is used if the measurement is made with a filter photometer.

4. Procedure

4.1. Treatment of sample. Pipet an aliquot of the acid-digested sample (see "Preliminary Treatment of Samples, 3.1") containing from 0 to 2.0 mg. of manganese into a 250-ml. conical flask. Add 25 ml. of water, 20 ml. of H_3PO_4 , and 0.3 g. of KIO_4 . Then heat the solution just below boiling about 10 min., cool, dilute to 100 ml. in a volumetric flask, and mix.

4.2. Measurement. Transfer portions of the colored solution to each of two cells. Either add 1 drop of $NaNO_2$ solution or a crystal of solid $NaNO_2$ to the reference cell and mix thoroughly with a stirring rod to destroy the color due to permanganate. Proceed as in 3.2.

Nickel

1,2-CYCLOHEPTANEDIONEDIOXIME (HEPTOXIME) METHOD*

Nickel is determined colorimetrically with heptoxime. Iron and copper are removed by extraction of the cupferrates with chloroform. The nickel is separated from other ions by extraction of the nickel heptoxime complex with chloroform, re-extracted into the aqueous phase with hydrochloric acid, and determined in the acidic solution with heptoxime in the presence of an oxidant.

1. Apparatus

1.1. Spectrophotometer or filter photometer equipped with a filter having a maximum transmittance near 445 m μ .

1.2. Separatory funnels, 125-ml. Squibb form with ground-glass stoppers.

1.3. Electrodeposition apparatus for standardizing the nickel stock solution.

2. Reagents

2.1. Acetic acid, glacial.

2.2. Ammonium hydroxide, concd.

2.3. Bromine water. Distilled water is saturated with bromine.

2.4. Chloroform, c.p.

2.5. Cupferron, aqueous 1 per cent. Store in refrigerator or make up fresh for each determination.

2.6. 1,2-cycloheptanedionedioxime (heptoxime) reagent. Ethanol (95 per cent) solution, 0.1 per cent. (Reagent not available commercially yet. Most likely obtainable from C. V. Banks, Iowa State College.)

2.7. Hydrochloric acid, 1.0 M.

2.8. Hydroxylamine hydrochloride solution. Dissolve 10 g. of $NH_2OH \cdot HCl$ in 90 ml. of water.

2.9. Methyl orange indicator. Aqueous solution containing 1 g. of indicator per liter of water.

2.10. Sodium hydroxide, c.p., 6 M.

2.11. Sodium tartrate solution. Dissolve 10 g. of $Na_2C_4H_4O_6 \cdot 2H_2O$ in 90 ml. of water.

2.12. Standard nickel sulfate stock solution. Dis-

solve nickel sulfate in distilled water so that the solution is about 1,000 p.p.m. in nickel. The concentration is best determined by electrodeposition of the nickel on a platinum gauze cathode. Transfer 50.00 ml. of the stock solution to a 250-ml. electrolytic beaker, neutralize with concd. NH_4OH , and then add 25 ml. in excess. Dilute the solution to about 125 ml. and electrolyze. If stationary electrodes are used, electrolyze at a current density of 0.2 to 0.3 amp. per sq. dm. When deposition is complete, wash the cathode with distilled water while lowering the beaker. Leave the current on during the operation. Detach the cathode, rinse again in distilled water, dip in ethanol, dry at 110°C. for 3 to 5 min., cool, and weigh. Dissolve the deposit by boiling the electrodes in concd. HNO_3 for at least 15 min., wash, dry, and reweigh the electrodes. From the amount of nickel in the aliquot, calculate the concentration of nickel in the solution.

3. Preparation of Calibration Curve

3.1. Treatment. Pipet aliquots of a standard nickel solution into 100-ml. volumetric flasks. The series should cover from 0.05 to 0.25 mg. of nickel, if 1-cm. cells are used. Add 25 ml. of HCl and 5 ml. of bromine water. Cool the flask containing the solution with cold water and add 10 ml. of concd. NH_4OH . Then immediately add 20 ml. of heptoxime reagent and 20 ml. of ethanol. Dilute to volume with distilled water and mix.

3.2. Measurement. Measure at 445 m μ 20 min. after addition of the reagent. The blank is prepared similarly except for omission of the nickel.

4. Procedure

4.1. Separation of copper and iron. Take an aliquot of the original sample prepared by digesting with H_2SO_4 and HNO_3 (see "Preliminary Treatment of Sample, 3.1") containing from 0.05 to 0.25 mg. of nickel, place in a separatory funnel, and add 10 ml. of sodium tartrate, two drops of methyl orange indicator, and enough $NaOH$ to make the solution basic to the indicator. Add 1 ml. of acetic acid and cool the solution by placing the separatory funnel under cold running tap water. Add 4 ml. of fresh cupferron reagent and extract any precipitate formed with 10 ml. of $CHCl_3$. Allow the layers to separate, and add more cupferron until a white silky precipitate forms, which indicates that an excess of cupferron is present. Shake the mixture, allow the layers to separate, and discard the $CHCl_3$ layer. Extract again with 10 ml. of fresh $CHCl_3$ and discard the $CHCl_3$ layer. Add 1 ml. of fresh NH_2OH solution, mix, and let stand for a few minutes.

4.2. Separation of nickel. Add 10 ml. of heptoxime reagent and extract the nickel complex with one 15-ml. and then two 10-ml. portions of $CHCl_3$. If the $CHCl_3$ layer is not colorless with the third extraction, continue until the $CHCl_3$ layer is colorless. Collect the $CHCl_3$ layers in a separatory funnel. Extract the nickel from the $CHCl_3$ by shaking with 15 ml. of HCl . After allowing the layers to separate, draw off the $CHCl_3$ layer into another separatory funnel and rinse.

4.3. Measurement. The solution is treated and the color measured as described in 3.1 and 3.2. If desired, dimethylglyoxime may be used to develop the color with nickel. The conditions of color formation are iden-

* New method of Ferguson and Banks, Iowa State College. Article in press for *Analytical Chemistry*.

tical with both reagents, but separate curves must be prepared. The rate of color development is slightly different for the two reagents so that with dimethylglyoxime, readings are taken at exactly 10 min. after addition of the reagent, whereas with heptoxime, readings are taken exactly 20 min. after addition of the reagent. Both systems are measured at 445 m μ . The heptoxime system is more stable. Dimethylglyoxime cannot be substituted for heptoxime in the extraction process under the conditions prescribed.

Zinc

Zinc is separated from other metals by extraction with dithizone and determined by measuring the color of the zinc-dithizone complex in carbon tetrachloride. Specificity in the separation is achieved by extracting from a nearly neutral solution containing bis(2-hydroxyethyl)dithiocarbamyl ion and cyanide ion, which prevent moderate concentrations of cadmium, copper, lead, and nickel from reacting with dithizone.

The color reaction is extremely sensitive, and precautions must be taken to avoid introducing extraneous zinc during the analysis. Contamination may arise from water, reagents, and from glassware (such as beakers and separatory funnels on which zinc has been adsorbed during previous use). Appreciable blanks are generally found, and the analyst must satisfy himself that these blanks are representative and reproducible.

1. Apparatus

1.1. Photoelectric filter photometer with green filter (ca. 535 m μ) or photoelectric spectrophotometer.

1.2. Separatory funnels, 125-ml. Squibb form with ground-glass stoppers.

2. Reagents

2.1. Acetic acid, glacial.

2.2. Ammonium hydroxide, zinc-free, 5 M. Commercial NH₄OH reagent usually contains zinc and is unacceptable. Prepare a concentrated solution by passing NH₃ gas from a cylinder into redistilled water and store the product in a plastic or a paraffin-lined bottle. If a cylinder of NH₃ gas is unavailable, c.p. ammonium hydroxide may be distilled using pyrex apparatus.

2.3. Bis(2-hydroxyethyl)dithiocarbamate solution. Dissolve 4.0 g. of diethanolamine and 1 ml. of CS₂ in 40 ml. of methanol. Prepare fresh every three or four days.

2.4. Carbon tetrachloride, zinc-free.

2.5. Dithizone solution, 0.01 per cent in CCl₄. Dissolve 50 mg. of diphenylthiocarbazone in 500 ml. of CCl₄. Keep in the dark in a cool place.

2.6. Dithizone solution, 0.005 per cent in CCl₄. Prepare a purified solution as follows: Measure 125 ml. of 0.01 per cent dithizone into a 500-ml. separatory funnel and add 100 ml. of water followed by 3 ml. of NH₄OH. Shake well and discard the CCl₄ layer. Add 125 ml. of pure CCl₄, make just acidic with HCl, and shake. Draw off the CCl₄ layer and wash it twice by shaking with 50-ml. portions of redistilled water, then dilute to 250 ml. with pure CCl₄. Keep in a cool, dark place and do not use if more than one week old.

2.7. Potassium cyanide solution. Dissolve 5 g. KCN in 95 ml. of redistilled water.

2.8. Sodium citrate solution. Dissolve 10 g. of

Na₃C₆H₅O₇·2H₂O in 90 ml. of water. Shake with 10 ml. of 0.01 per cent dithizone in chloroform to remove zinc, then filter.

2.9. Sodium sulfide, 1 per cent solution. Dissolve 3.0 g. of Na₂S·9H₂O in 100 ml. of water.

2.10. Sodium sulfide, 0.04 per cent solution. Prepare just before use by diluting 4 ml. of 1 per cent Na₂S to 100 ml.

2.11. Zinc-free distilled water for preparation of reagents and dilution water. Ordinary distilled water usually contains traces of zinc, and should be redistilled using an all-pyrex apparatus.

2.12. Zinc standard solution, 1.000 mg. zinc per ml. Dissolve 1.000 g. of c.p. zinc metal in 10 ml. of 1:1 HNO₃. Dilute and boil to expel oxides of nitrogen. Transfer to a 1,000-ml. volumetric flask, dilute to volume, and mix.

3. Preparation of Calibration Curve

Prepare just before use a zinc solution containing 0.00200 mg. of zinc per ml. by diluting 5 ml. of the standard zinc solution to 250 ml., then diluting 10 ml. of the latter solution to 100 ml. with redistilled water. Pipet 5.00, 10.00, 15.00, and 20.00-ml. portions of the resulting solution into separate 125-ml. separatory funnels and adjust the volumes to about 20 ml. Another funnel containing 20 ml. of water is carried through as a blank. Add two drops of methyl red indicator and 2.0 ml. of sodium citrate to each; if the indicator is not yellow at this point, add NH₄OH a drop at a time until the indicator just turns yellow. Next add 1.0 ml. of KCN and then sufficient acetic acid a drop at a time just to turn the indicator to a neutral peach color.

Extract the methyl red by shaking with 5 ml. of CCl₄ and discard the yellow CCl₄ layer. Then add 1 ml. of methanolic bis(2-hydroxyethyl)dithiocarbamate. Extract with 10 ml. of purified dithizone, shaking for 1 min. Draw off the CCl₄ layer into another separatory funnel and repeat the extraction with successive 5-ml. portions of dithizone until the last one shows no change from the green dithizone color when viewed by transmitted light. Discard the aqueous layer.

Shake the combined dithizone extracts with 10 ml. of 0.04 per cent Na₂S, then separate the layers and repeat the washing with further 10-ml. portions of Na₂S until the unreacted dithizone has been completely removed, as shown by the aqueous layer remaining colorless or very pale yellow; usually three such washings are sufficient. Finally, remove any water adhering to the stem of the funnel with a cotton swab and drain the pink CCl₄ solution into a dry 50-ml. volumetric flask, using a few milliliters of fresh CCl₄ to rinse the last droplets from the funnel. Dilute to the mark with fresh CCl₄.

Determine the absorbancy of the zinc dithizonate solutions at 535 m μ and plot an absorbancy-concentration curve after subtracting the absorbancy of the blank. The calibration curve is linear if monochromatic light is used.

If large or erratic blanks are obtained despite the exercise of care in purifying water and reagents, it is probably caused by zinc adsorbed on the glass surface

(Concluded on page 63)

A Simple Instrument for Evaluating Polished or Buffed Surfaces

By G. E. Gardam, Ph.D., A.R.C.S., F.R.I.C., F.I.M.*

THE satisfactory appearance of polished metal articles depends on two independent properties — "surface truth" and "surface lustre."¹ The latter is readily obtainable by various methods of buffing, most of which depend on rubbing and flowing the surface with a soft pad and a finely divided and relatively infusible oxide. The surface truing, or smoothing, process consists of one or more successive fine polishing operations without any attempt to flow the metal. Its object is to smooth and true the surface so that when it is subsequently buffed the images seen in the surface will be clear and unblurred, and their distortion will be due to the general curvature only. However, it is not possible to determine by simple inspection that the smoothing process has achieved its purpose, since the surface is usually covered with scratches which confuse the detail of the image and diffuse the reflected light. In consequence it is difficult, except by experience or trial, to determine when the polishing process has been carried far enough; any estimation of the amount of polishing required by the original surface is still more difficult.

In any systematic study or comparison of polishing processes the need is felt for some quantitative measure of the initial roughness of the surface; any simple method might also be useful in the factory and polishing department. A very simple method is described below for this purpose; its obvious shortcomings may to some extent be offset by its simplicity.

*From a paper published in the *Journal of the Electrodepositors Technical Society*, 1950, 26.

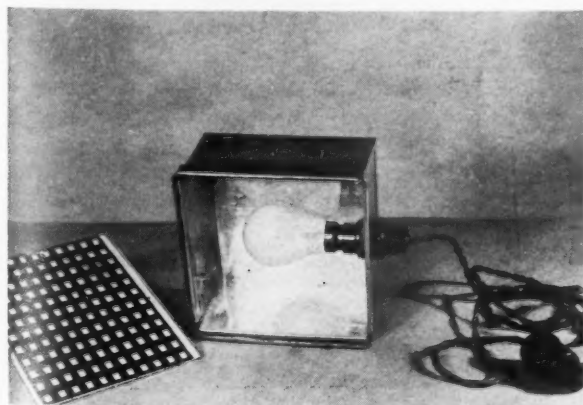


Figure 1. Showing simplicity of apparatus required.

The method consists of the inspection, under standard conditions, of the reflected image of a strongly illuminated pattern of light and dark stripes, and the determination of the maximum distance between lamp and object at which the light and dark stripes can be separately distinguished. The result is broadly independent of the curvature of the surface, and can be applied to relatively non-reflective surfaces, or alternatively

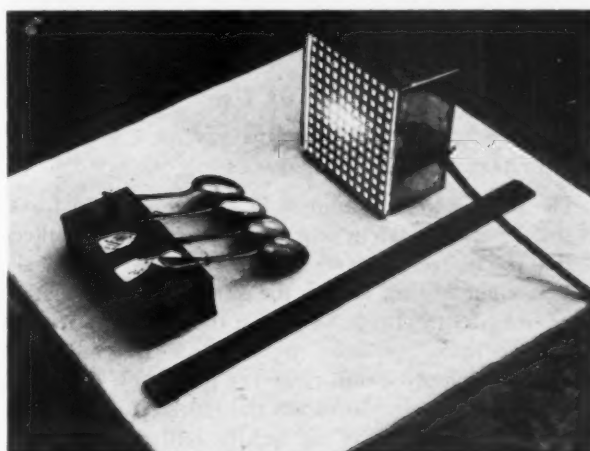


Figure 2. The image of the illuminated grid is inspected at right angles while the article is withdrawn from the lamp. The maximum distance at which the light and dark areas can be separately distinguished is a measure of the quality of the surface.

these can be increased in surface reflectivity. The same apparatus is useful as a general qualitative inspection lamp for quality of polish, absence of major defects, and also for the absence of haze and bloom.

Description of the Apparatus

The apparatus is shown in Fig. 1, and consists of a box containing an electric lamp. The front of this box consists of a screen of paper ruled with a pattern of alternate black and clear stripes in two directions at right angles. The black and clear stripes are of equal width. The width of the stripes can be varied for the type of surface to be examined. For hot-rolled and pickled sheet metal, and for spun, pressed or drawn work, a width of $\frac{1}{4}$ " is suitable. For cold-rolled or good quality articles, and for qualitative inspection of polished surfaces, a narrower width, e.g. $\frac{1}{10}$ " is more useful.

It will be obvious that this apparatus presents no difficulty in construction. Its exact form is best deter-



Figure 3. Use of test on lustrous but "untrue" surfaces. The three right-hand spoons have been electrolytically polished. The two on the left were mechanically polished. Note the comparative confusion of the images.

mined by the materials at hand, but the model illustrated was made from a tinplate cake tin to which three tinplate slides for the screen were soldered. The patterned screen is also easily prepared from translucent paper. This should be attached to a sheet of window-glass with paste, gum or rubber solution. The transparency of the white areas can be increased by oiling the paper.

Method of Use

FOR MEASUREMENT OF THE QUALITY OF UNPOLISHED OR PARTIALLY POLISHED SURFACES

The surface to be examined is held squarely in front of the screen and fairly near to it. The surface is tilted so that the image of the screen can be seen from a position at right angles. Unless the surface is very matte, some images can always be seen at the nearer positions. For very matte surfaces, however, it is sometimes necessary to apply a thin clear (or preferably black or red) oil or varnish coat to aid the reflectivity. Alternatively, the surface may be lightly buffed or rubbed with a domestic metal polish. Any of these methods increase the reflectivity of fairly rough surfaces without markedly changing their surface "truth." It is essential to hold the surface steady while the distinctness of the image is being inspected as it has been found that a surface which gives a blurred and indistinct image when held still gives the impression of clarity when rapidly oscillated. This is probably due to an optical effect known as "the persistence of vision."

It will be found that although at the nearest possible position a clear (but not necessarily bright) reflection of the pattern is seen, as the article is withdrawn this becomes confused. The withdrawal is continued until it is no longer possible to distinguish separately the reflection of the bright squares and black stripes. The distance between the screen and the article is then measured. It is most important to realize that only the clarity of the image is under inspection, and neither its brightness nor size are important to this test.

The test is well adapted to approximately flat or to convex or concave articles. It is, however, not very effective on surfaces of concave curvature in one direction and convex curvature in a direction at right angles

(i.e. saddle shaped). It is obviously not very suitable for very sharply curved, embossed or highly patterned articles, but for such surfaces a test of surface truth is seldom required. The test can readily be used under ordinary conditions of illumination.

The point at which the black and white stripes can no longer be separately distinguished is not, of course, sharply defined, but it has been found that separate observers agree quite well. An accuracy of $\pm 10\%$ ($\pm \frac{1}{2}$ " on 5" or ± 2 " on 20") is all that is required. Where the curvature is great (radius of curvature less than 2") and distance of withdrawal considerable, the diminution of the image makes observation difficult. In such cases the use of a hand lens is helpful, but generally the unaided vision is sufficient.

The measurements so obtained cannot be directly converted into the amount of buffing, etc., required, since there is as yet no quantitative way of expressing this. However, they are valuable in comparing similar articles on the basis of the known amount of buffing required by one of them. The experience of the author suggests that articles giving a measurement (using the $\frac{1}{4}$ " screen) of less than 5" require very considerable sand buffing or light emery scurfing. Articles which can be withdrawn 10" or 12" require fairly heavy buffing with grease-bonded tripoli or equivalent, whereas articles whose measurement is 20-24" can be finished to a highly reflective and true surface with a soft buff and finishing compound only.

FOR EXAMINATION OF LUSTROUS BUT "UNTRUE" SURFACES

The instrument can be used for the inspection on a semi-quantitative basis of highly reflecting, but poor



Figure 4. Use of test for examination of symmetry. Note the distortion of image of grid.

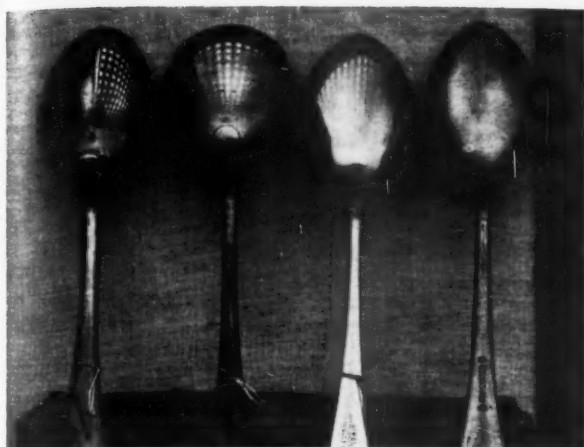


Figure 5. Appearance of reflection in four unbuffed spoons made by different manufacturers. These required different amounts of buffing which was revealed by the test but not easily appreciated by simple inspection.

quality, finishes. For this purpose a finer screen, for example, of 1/10" stripes, is preferable. As before, either the sharpness and clarity of the image is qualitatively observed or the distance of withdrawal before confusion occurs is measured. The distances are in general greater than in the first test with consequent difficulties due to diminution of the image, but the higher reflectivity assists greatly. The test is very useful for demonstrating the superiority of finishes produced by a previous careful "cutting down" operation or for comparing the quality of two different articles. It is also very useful for assessing the value of new or improved methods such as electropolishing. (Fig. 3)

FOR EXAMINATION OF SYMMETRY, MINOR SURFACE DEFECTS, LARGE-SCALE DENTS, ETC.

The article is set at an intermediate distance, preferably using the finer grid, so that the reflected pattern is quite clear. The distorted image of the rectilinear pattern is examined as a whole. Local distortions superimposed on the general distortion, due to dents, lack of symmetry, or surface defects, are then readily apparent. See Figure 4.

DETECTION OF SURFACE HAZE AND CONFIRMATION OF BLACK POLISH

The "buffing" or "flowing" step in metal polishing produces a lustrous reflective surface from a previously smoothed but matte one. It often leaves, however, a multitude of very fine scratches which scatter a proportion of the light. The instrument described can be used to estimate the quality of the surface at this stage. The coarser screen is used or preferably a different type of screen, most of which is opaque with a few small transparent spots. The article is set at an intermediate distance where the image of the pattern is quite clear. The reflection of the black areas is then carefully examined for faint light reflection (haze) or sparkle (scratches). This test is best carried out in a darkened room.

Conclusion

It is possible that this test will be found sufficiently simple and useful for a lamp with appropriate screen to be provided for each polisher and inspector. Inspec-

tion of an article near this lamp and visual estimation of the clarity of the image and the distance between lamp and article could then be carried out so quickly that no interference with routine would occur, while a positive check on surface quality could be maintained.

Acknowledgment

This paper describes work carried out for the Design and Research Centre, for Gold, Silver and Jewelry Industries, and is published by permission of the Council of the Centre.

Reference

1. Gardam and Mills, *Jour. Electrodepositors Tech. Soc.*, 1947, 24, 17.

COLORIMETRIC DETERMINATION OF METALS IN INDUSTRIAL WASTES

(Concluded from page 60)

of the separatory funnels. These should be rinsed with 4 M HNO_3 , then with distilled water, and finally shaken for several minutes with 5 ml. of sodium citrate and 5 ml. of dithizone. If possible, separatory funnels used for zinc analyses should be reserved for this purpose and not used for other determinations.

4. Procedure

4.1. Take an aliquot of the sample (see "Preliminary Treatment of Samples, 3.1") containing between 10 and 40 micrograms of zinc, transfer to a clean 125-ml. separatory funnel, and adjust the volume to about 20 ml. Determine the zinc in this solution exactly as described in 3 for preparing the calibration curve.

Generally not more than 30 ml. of 0.005 per cent dithizone should be needed to extract the zinc completely; if more is required, the aliquot taken contains too much zinc or the quantity of other metals which react with dithizone exceeds the amount which can be withheld by the complexing agent. In the latter case, procedure 4.2 should be followed.

4.2. Separation of excessive amounts of cadmium, copper, and lead. This procedure should be followed when the quantity of these metals, separately or jointly, exceeds 2 mg. in the aliquot taken. Place the aliquot in a 100-ml. beaker, adjust the volume to about 20 ml. and the acidity to 0.4 to 0.5 N, by adding dilute HNO_3 or NH_4OH as necessary. Pass H_2S into the cold solution for 5 min. Filter off the precipitated sulfides using a sintered glass filter, washing the precipitate with two small portions of hot water. Boil the filtrate 3 or 4 min. to remove H_2S , then cool, transfer to a separatory funnel, and determine the zinc as described in 4.1.

Acknowledgment

The authors wish to express their appreciation to the United States Public Health Service for financial support of this project through a research grant from the National Institutes of Health, and to the Federation of Sewage Works Associations under whose auspices the research was conducted. Special thanks are due W. D. Hatfield, the coordinator for the project.

The Function of Sulphites and Bisulphites in Cyanide Plating Solutions

By Joseph Haas, *Industrial Engineer*

THE introduction of metal cyanide salts, copper cyanide (CuCN) and zinc cyanide ($\text{Zn}(\text{CN})_2$), not only simplified the method of making plating solutions, but also resulted in better plated products, and uniform, increased production. Plating solutions began to have less "shut down" time while the plater was trying frantically to "dope" them up for resumption of operation.



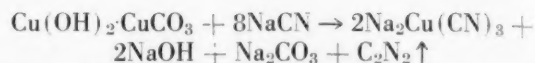
Before the advent of these metal cyanides, the desirability and advantages of the chemical control of plating solutions was not generally appreciated nor practiced, perhaps fortunately. Otherwise the job of determining the amounts of all the materials then poured in to make a plating solution would have been a complex job. Furthermore, the complex function of all the materials used was neither fully understood nor determined, not to mention all the possible complexes that were built up in the bath after some operation.

What little chemical control was practiced concerned itself primarily with the determination of metal content, "free" cyanide, and possibly carbonate. The building up of carbonate was looked upon as the plater's greatest troublemaker. It probably was, and in many cases today, still is.

But chemical analysis was found, as it still is today, not to be the complete answer to steady, uniform, and good quality production plating. Those platers who had to use the old methods of making cyanide plating solutions, when all other tricks failed to produce satisfactory results, resorted to the use of certain addition chemicals, the use of which has disappeared through the years. With metal content, free cyanide, and current operating conditions being satisfactory, these addition chemicals invariably did the trick. This paper will discuss one such practice, the use of sulphites and bisulphites in copper cyanide and brass solutions.

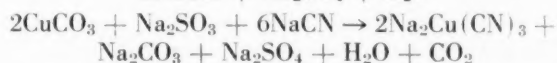
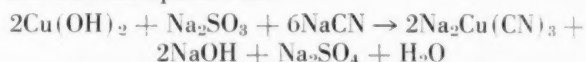
After a period of two years' extensive use of sulphites in cyanide solutions operating in plants on a production basis, confirmed by laboratory experiments, the writer has reached the conviction that bisulphites and sulphites are of distinct value in the operation of cyanide copper and brass solutions.

Before the introduction of metal cyanides, plating solutions were made up of basic copper carbonate ($\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$). If the plater dissolved the basic copper carbonate in sodium cyanide, the following reactions took place:



The evolution of cyanogen gas (C_2N_2) was a natural reaction in the reduction of the basic copper carbonate from the cupric (Cu^{++}) state to the cuprous (Cu^+) state in the formation of the complex sodium cuprous cyanide.

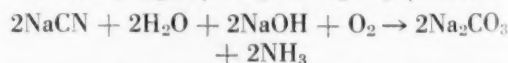
To prevent this waste of cyanide, the plater was told to incorporate sodium sulphite (Na_2SO_3), a cheap reducing agent, in his slurry of basic copper carbonate, and then pour this mixture into his prepared cyanide solution. Care had to be taken in the process, since a great deal of heat was generated, to keep the temperature down; otherwise black cupric oxide (CuO) would be formed which was difficult to redissolve. The reaction that took place was:



The sulphite effected a reduction of the cupric salt (Cu^{++}) to the cuprous (Cu^+) without any waste of cyanide in forming the complex sodium cuprous cyanide.

Such a solution always gave the plater beautiful, lustrous copper deposits. When in time the deposits became dull and muddy in appearance, and the anodes did not clear up upon turning off the current, nor upon the addition of moderate amounts of cyanide, the plater found his answer in the addition of bisulphite or sulphite. At this time, it is advisable to point out that the proper addition would have been the sulphite, when the only problem was to clear the anodes.

The copper cyanide solution (or brass) contains sodium carbonate (Na_2CO_3) from three possible sources, one being the primary addition as a part of the formula. Additional increase in the carbonate content comes from either of the following reactions, or more probably from both simultaneously, especially with heated solutions.



In the operation of copper cyanide solutions, experience and observation shows that the anodes at various times have been found coated with a black coating of cupric oxide (CuO), a brown coating of cupric-cuprous oxide ($\text{CuO} \cdot \text{Cu}_2\text{O}$), cupric oxide combined with cuprous carbonate ($\text{CuO} \cdot \text{Cu}_2\text{CO}_3$), or bluish basic copper carbonate ($\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$). In the case of brass solutions, we have various zinc compounds formed

which may change the color of the above anode coatings somewhat.

The coatings upon the anodes become troublesome as the carbonate content increases, regardless of the fact that the free cyanide content is maintained at a predetermined value, as per original formula. The anode products, which originally probably consisted principally of metal cyanides, now predominate in the compounds mentioned above, which are less readily soluble in the free cyanide. Nor does it take much imagination to understand that, during the process of electrolysis with the solution in the anode area loaded with various foreign and undesirable anions, the solvent action of the free cyanide is diluted, and the reactions so slowed down as not to be able to keep pace with cation deposition. Therefore the entire process slows down, and the plater says his solution is working "sluggish." How otherwise could we explain that, as the carbonate content increases, it has been found necessary to extend the limits of the "free" cyanide content beyond that of the original formula in order to keep the anodes clean? Also, the necessity for adjusting the free cyanide content is found to become more frequent. This more frequent requirement for "free" cyanide adjustment can reasonably be explained: there is a slow loss of cyanide according to the reaction involving the formation of basic copper carbonate on the anode, and other salts in the cupric state.

This problem of increasing the limits of the "free" cyanide content brings us into additional difficulties, such as a decrease in cathode efficiency and blistered deposits. In brass solutions, increasing the "free" cyanide limit can find the plater obtaining deposits of a reddish tint (zinc red) due to the increase of zinc in the deposit, whereas before he received satisfactory brass colored deposits with his established Cu/Zn ratio.

Since the carbonates are the cause of so much trouble, the obvious remedy would be to remove the carbonates. Standard methods of carbonate removal are well known, and need not be discussed as they have no bearing on the purpose of this article. We are concerned here with the problem of preventing the increase in the carbonate content from interfering with plating production; it is not always possible at a production peak to stop the production line to remove the carbonates.

Since increasing the limits of the "free" cyanide content leads to the difficulties mentioned above, the situation can be remedied by introducing a reducing agent, sodium sulfite (Na_2SO_3), to reduce the basic cupric salts on the anodes to the more readily cyanide-soluble cuprous salts, thereby eliminating, or at least minimizing, the necessity of increasing the free cyanide limits.

To be specific, the writer can state from personal practice that the use of sodium sulphite in excess in copper cyanide (or brass) solutions has a beneficial effect, resulting in the production of lustrous and bright deposits and promoting efficient anode solution. Consequently, predetermined current densities can be maintained at a minimum of applied voltage.

There is nothing new in this statement. Referring to some old authorities:

Schlötter says—"In the course of electrolysis, a green

layer forms on the anodes. This is probably cupro-cupric cyanide, and it offers an enormous resistance to the passage of the electric current. The formation of this layer is more easily avoided by the addition of sulphite to the bath, and more easily dissolved when it (sulphite) is present."

Brochet says—"The sulphite acts as a reducing agent of any copper present in the cupric state, itself being oxidized to a sulphate."

On the subject of sulphites, there remains one more subject to discuss. If the accumulation of carbonates is undesirable in a copper cyanide solution, what is the effect of the accumulation of sulphates, resulting from the oxidization of sulphite, upon the bath and upon cathode efficiency? According to Hull, sodium sulphate effects an increase in the conductivity of copper cyanide solutions, and does not effect the cathode efficiency detrimentally.

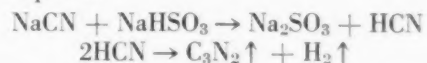
Use of Bisulfite

Up to now we have discussed only the use of sulphite in the cyanide solutions. When should the bisulphite (NaHSO_3) be used?

In cyanide copper or brass solutions, when it is desired to lower pH, we find two methods recommended. One method recommends the cautious addition of dilute sulphuric acid; the other method recommends a solution of sodium bicarbonate (NaHCO_3). Both methods in addition to lowering pH cause the evolution of hydrogen cyanide gas. The writer recommends the use of sodium bisulphite instead. The danger of hydrogen cyanide evolution is the same, but the substitution has the advantage of adding to the solution the reducing anion SO_3^- , instead of building up the solution with the undesirable CO_3^- anion.

The bisulphite should be dissolved in water, or, depending upon the quantity required to reduce the pH to a desired value, in a large bulk of the solution outside of the tank, added to the main body of the solution, and thoroughly stirred in. As an example, a brass solution having a pH 12.3 (colorimetric) after being treated with sodium bisulphite had a pH 11.2.

Sodium bisulphite is beneficial and useful for another purpose in cyanide solutions, and that is in the reduction of excess cyanide, instead of the usual recommended practice of accomplishing this reduction with dilute acids. Of course, the danger of evolving cyanogen gas is also present. Likewise, pH will be lowered, and will require subsequent adjustment. Here again it is better to utilize the reducing anion SO_3^- instead of adding anions of no specific value. The following reaction takes place:



A brass solution having a "free" cyanide content of 3.40 ozs./gal. was, by the addition of sodium bisulphite, reduced to 1.30 oz./gal.

References

- Blum and Hogaboom — *Electroplating and Electroforming*, 2nd Edition, pp. 219-224.
- Hughes — *Modern Electroplating*, p. 114.
- Rosslyn — *Electroplating and Anodizing*, p. 99.
- R. O. Hull — *Effect of Carbonates and Sulphates upon Operating Characteristics of Cyanide Plating Solutions* — Proc. A. E. S. 1938, p. 195-196.

Protecting Against White Rusting of Zinc Plated Parts

By P. T. Gilbert and S. E. Hadden, *British Non-Ferrous Metals Research Ass'n., London, Eng.*

Various chromate treatments for the protection of zinc plated parts are discussed by these authors, as well as the mechanism of the corrosion of zinc.—Ed.

IT is known that chromating by dipping in strong acidified sodium dichromate solution affords very good protection to zinc. The results given in Table I show that during 1 week's test almost complete protection is afforded against 100% Relative Humidity with intermittent distilled water spray or 3% sodium chloride solution spray.

This process is too expensive for general application to galvanized goods and, moreover, the yellow color produced is often objectionable, but it is used in special cases where high corrosion-resistance is essential. A less effective and temporary protection would, however, be sufficient to prevent the worst effects of white rusting.

A dip in 0.07% unacidified sodium dichromate solution at 65°C., which does not discolor the surface, was known to provide some protection. Specimens treated in this way received considerable protection against the effects of the distilled-water-spray test. The minimum time of dip necessary to give the optimum effect was found to be about 30 sec. (see Fig. 1), and dips of this duration or longer reduced the loss in weight by as much as 80% of the value for untreated specimens.

TABLE I—Protection Afforded to Galvanized Sheet by Chromate Treatment to D.T.D. 923

Treatment of Galvanized Sheet	Total Loss of Weight in 1 Week, oz./ft. ²	
	Distilled Water Spray	3% NaCl Spray
None	0.047	0.072
Chromated to D.T.D. 923*	0.002	0.003

*The chromating solution specified contains 200 g. sodium dichromate crystals and 6.6 c.c. conc. H₂SO₄ in 1 l. H₂O.

In the distilled-water-spray test specimens dipped in 0.07% dichromate solution to which a wetting agent had been added, lost 20% more weight than specimens from the same solution without the wetting agent. Dipping at 75°C. instead of 65°C. caused no significant improvement, nor did the use of a 0.1% instead of a 0.07% solution.

To investigate the effects of solutions with a range

(Abstracted from the *Journal of the Institute of Metals, London.*)

of dichromate contents, specimens were dipped for 30 sec. in the following series of solutions:

- (a) 0.07%—5% dichromate, unacidified, at 65°C.
- (b) 0.07%—5% dichromate with H₂SO₄ in the same ratio as in D.T.D. 923, at 40°C.
- (c) As (b), but at room temperature.

The results of these tests are given in Fig. 2, which shows that very good protection results from dipping in acidified 1% sodium dichromate solution for 30 sec. at room temperature or at 40°C. In all cases the sheets dipped in the 5% solutions were yellowish in color; there was practically no color on those dipped in the other solutions, except a slight coloration on those dipped in the acidified solutions at 40°C.

A series of specimens were dipped in 1% acidified dichromate solution at room temperature for various times and subjected to the distilled-water-spray test. The results are given in Fig. 3, which shows that 10-15 sec. dip is sufficient to give nearly the maximum protective effect.

In view of the promising results of these chromate treatments it was considered that it might be advantageous to quench galvanized articles in dilute chromate solutions instead of in water. Accordingly, specimens were galvanized for 1 min. in a bath at 450°C. containing 1% lead, by prefluxing in hot saturated ammonium chloride solution and scattering a little ammonium chloride on the bath during withdrawal. The specimens were quenched in (i) water, (ii) 0.07% un-

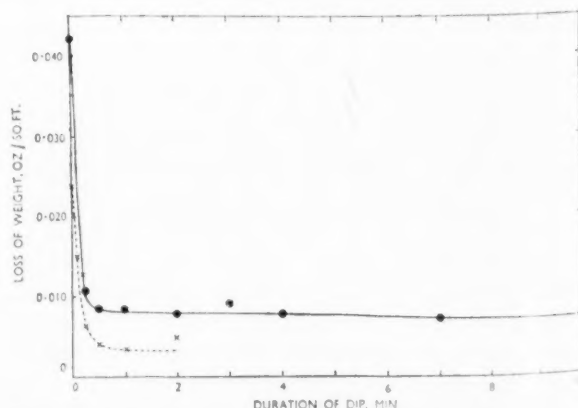


Figure 1. Effect of Dip in Sodium Dichromate on Corrosion of Galvanized Sheet in Distilled-Water-Spray Test. 1 week's test. (Different spraying nozzles used for the 2 tests.)

acidified sodium dichromate solution, or (iii) 1% acidified sodium dichromate solution, and held in the quenching baths (all at room temperature) for 5 sec. They were then dried with a cloth and subjected to 1 week's distilled-water-spray test. The behavior of these specimens was compared with that of other specimens which were similarly galvanized, quenched in cold water, and subsequently dipped for 5 sec. in 0.07% unacidified dichromate solution at 65°C. or 1% acidified dichromate solution at 50°C. The results are given in Table II.

These results show that good protection against white rust was given by quenching from the galvanizing bath into either 0.07% unacidified or 1% acidified dichromate solutions, both cold, even though the time of immersion was only 5 sec. The protection afforded was much better, especially with the weaker solution, than that afforded by quenching in cold water and subsequent immersion for 5 sec. in the corresponding hot chromating solutions.

If this method is to be of practical use the chromating solutions must not be adversely affected by the accumulation of flux residues in the quenching bath. Specimens were therefore chromated by immersion (a) for 30 sec. in 0.07% unacidified dichromate solution at 65°C., and (b) for 10 sec. in 1% acidified dichromate solution at 50°C., with and without 2% of added zinc ammonium chloride in each solution. The specimens were then subjected to a week's distilled-water-spray test. In neither case did the presence of the chloride flux residue adversely affect the protection afforded by the chromate treatments.

TABLE II—Effect of Quenching in Dichromate Solutions on Corrosion in Distilled-Water-Spray Test

Specimen and Treatment	Loss of Weight after Test, oz./ft. ²
Galvanized and cold-water quenched	0.025
Galvanized and quenched in cold 0.07% unacidified dichromate solution	0.007
Galvanized and quenched in cold 1% acidified dichromate solution	0.002
Galvanized, cold-water quenched, and subsequently dipped 5 sec. in 0.07% unacidified dichromate solution	0.018
Galvanized, cold-water quenched, and subsequently dipped 5 sec. in 1% acidified dichromate solution	0.005

Further specimens were galvanized through a thick zinc ammonium chloride layer, quenched in cold water or in 0.07% unacidified or 1% acidified dichromate solutions, and hung up to drain. These were then exposed in a 100% relative humidity tank for 3 months. The specimens which had been quenched in the dichromate solutions remained bright and suffered no serious attack, while those quenched in water tarnished quickly and showed fairly severe local attack after the test, probably at places where traces of flux residues remained.

Another series of distilled-water-spray tests showed that the protective effect of chromating (with 0.07% unacidified or 1% acidified solutions) was the same whether the specimens were rinsed after chromating or not. A disadvantage of omitting to rinse, however, is that the coatings retain yellow stains.

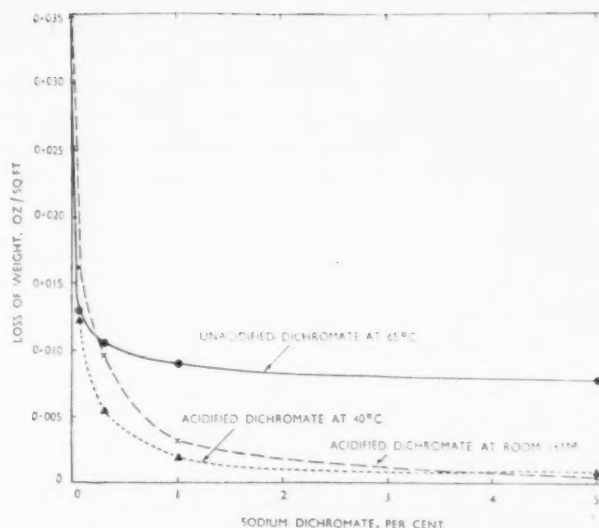


Figure II. Protection afforded by various Chromate Treatments. 1/2-min. dip in all cases. 1 week's distilled-water-spray test.

Mechanism of White Rust Formation

White rust formed on zinc or galvanized surfaces in moist uncontaminated air has usually been found, both in laboratory tests and in practical instances, to consist mainly of a basic zinc carbonate. X-ray analysis has shown this basic carbonate to be usually identical with the compound precipitated from zinc sulphate solution by sodium carbonate, to which the formula $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$ has been given. These findings agree with those of Morral.² In some cases the compound formed gives an X-ray diffraction pattern in which the relative intensity of one of the lines is different from usual. This presumably indicates some slight modification in the structure of the basic carbonate.

When white rust attack occurs in air free from carbon dioxide, X-ray analysis of the corrosion product after drying in air for a day or two reveals zinc oxide only. Moreover, white rust samples containing varying proportions of zinc oxide and basic zinc carbonate have been obtained, the proportion of oxide tending to increase when access of air is restricted, e.g. in the interior of coils of wire. In one industrial instance the corrosion product on coils of fine-gauge electroplated wire was found to consist of zinc oxide and basic zinc carbonate in an approximately 2:1 ratio. These findings are also similar to those of Morral.^{1, 2}

Zinc hydroxide has not been detected by X-ray analysis of any sample of white rust produced in the present laboratory tests, although in one practical instance α -zinc hydroxide appeared to be present. The failure to detect zinc hydroxide may be either because none is there, or because it occurs in an amorphous form. This latter possibility is not unlikely. For instance, the corrosion product on galvanized sheet immersed in cold supply water was found on X-ray analysis to be completely amorphous, and no pattern was obtained.

A product containing α -zinc hydroxide, which was prepared by precipitation from zinc sulphate solution with caustic soda in the absence of carbon dioxide, gave an X-ray diffraction pattern different from either zinc oxide or basic zinc carbonate; the material changed partly to zinc oxide on standing in the laboratory at room temperature for a few days. Some forms

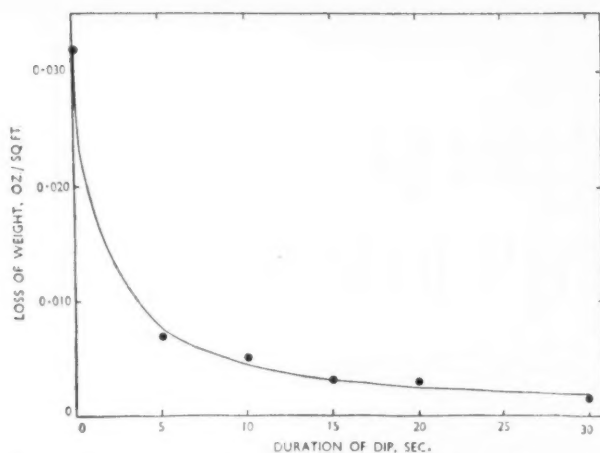
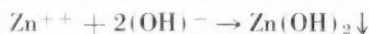


Figure III. Effect of Dip in Acidified 1% Sodium Dichromate Solution on Corrosion of Galvanized Sheet in Distilled-Water-Spray Test. (Each point represents average loss for 2 specimens.) 1 week's test.

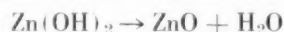
of zinc hydroxide can therefore dehydrate readily at room temperature.

It is suggested that the primary electrochemical reaction leading to the formation of white rust in the presence of air and water is:

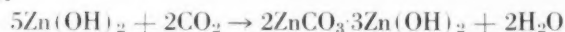


zinc hydroxide being precipitated by interaction of the products from adjacent anodic and cathodic areas.

Secondary reactions which then occur are probably:

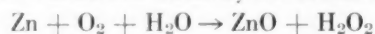


or



Support for the view that the formation of basic carbonate is a secondary reaction is given by the fact that the amount of corrosion occurring in the spray test was the same whether ordinary air or CO_2 -free air was used (Table II), although the corrosion product was basic zinc carbonate in the one case and zinc oxide in the other.

It is considered that this mechanism is more probable than that favored by Morral,¹ involving the primary formation of zinc oxide by the reaction:



Even if this reaction did occur, it would appear to be difficult to account for the subsequent formation of basic zinc carbonate, in view of the finding quoted by Morral that "ZnO-H₂O, once dehydrated cannot take up water to form zinc hydroxide."

Chemical analysis of the corrosion product formed in the distilled-water-spray test (in air containing the normal amount of CO_2), supports the view that the chief substance present is the compound $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$, as shown in Table III.

The composition of the corrosion product is thus intermediate between that of $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$ and that of $\text{ZnCO}_3 \cdot 2\text{Zn}(\text{OH})_2 \cdot \text{H}_2\text{O}$. X-ray analysis showed that both the samples contained small amounts of zinc oxide; this would account for the zinc figure being higher and the combined CO_2 figure being lower than in $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$. The basic carbonate present therefore seems likely to be $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$.

Observations by Feitknecht and Petermann³ during work on the chemistry and morphology of zinc corro-

sion products are of interest in connection with the present work. These workers show that six well-defined forms of zinc hydroxide exist, several of which are formed when zinc corrodes in immersed conditions. The stable form is ϵ -zinc hydroxide, and other forms tend to change to this. α -, β -, and amorphous zinc hydroxide are all unstable, and may change either to zinc oxide or to more stable forms of hydroxide. Feitknecht and Petermann found that when zinc corroded in distilled water the chief corrosion products, which were probably formed by transition of the first-formed amorphous zinc hydroxide, were β -zinc hydroxide and zinc oxide.

TABLE III—Composition of White Rust of Basic Zinc Carbonates

	Theoretical Composition of $2\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$	Theoretical Composition of $\text{ZnCO}_3 \cdot 2\text{Zn}(\text{OH})_2 \cdot \text{H}_2\text{O}$	Analysis: Sample 1	Analysis: Sample 2
Zinc, %	59.5	57.4	58.4	58.5
Combined CO_2 , %	16.0	12.9	14.5	26.6
Combined water, %	9.8	15.8	---	
Remainder (combined oxygen), %	14.6	14.0	---	(14.9)

The presence of zinc oxide in white rust, and the failure to detect zinc hydroxide, is therefore not surprising. The conditions evidently favor the ultimate formation of zinc oxide, or in the presence of carbon dioxide, basic zinc carbonate.

Feitknecht and Petermann confirm that electrochemical action plays an important part in the corrosion of zinc in distilled water. They conclude that the speed of the reaction is largely controlled by the protective action of the corrosion product, which depends on its chemical nature, and on its mode of formation.

During the experiments on corrosion by pools of distilled water, there was a tendency for the most severe attack to occur as a band of localized pitting round the perimeter. Once the oxygen initially present has been used up, the availability of oxygen is greatest round the perimeter, since the diffusion path through the liquid is shortest here. There is, however, no well-defined outer cathodic zone with a central anodic area such as occurs when a pool of sodium chloride solution is placed on steel. This is because of the low conductivity of the distilled water and also because the rate of attack of zinc by distilled water is less than that of steel by chloride solution, and differences of oxygen concentration in the pool are therefore less readily established. Corrosion therefore proceeds very close to the most effective cathodic zones at the perimeter. Some localized attack less intense than that at the perimeter would, however, be expected in the center of the pools. The distinction between the inner zone and the outer zone of intense localized attack becomes more noticeable as the size of the pool increases. This electrochemical mechanism explains why a given volume of water as small pools causes more corrosion than the same volume as large pools, the average intensity of attack per unit area being greater with the smaller pools.

Severe corrosion can be produced in moist environments containing substances other than ordinary air, but in these cases the mechanism may be different. Thus, in the presence of sufficient sulphur dioxide,

white deposits on the surface, and much attack occurs with the formation of zinc sulphate. In the presence of hydrochloric acid vapor the corrosion product is largely zinc oxychloride. In the presence of vapors of organic acids the rate of attack is also much increased, and zinc salts of fatty acids have been detected in the corrosion products.

On the other hand, when relatively large amounts of ammonia or carbon dioxide are present in the atmosphere the rate of attack is reduced, owing presumably to the production of corrosion products in a more protective form.

Practical Implications

White rusting in practice may be due to one of three causes:

(1) The action of condensed or entrapped water which remains on the surface for periods of more than a few hours.

(2) The action of certain acid vapors in moist atmospheres (particularly sulphur dioxide, hydrochloric acid, and organic acids).

(3) Flux residues on galvanized surfaces.

To avoid white rusting it is necessary to ensure that none of these causes is present, or alternatively to give some protection to the zinc coatings; a simple chromate treatment such as a 10 sec. dip in an acidified 1% sodium dichromate solution has been found to give good protection. It would also be advantageous to quench articles in dilute dichromate solutions immediately after galvanizing; this should give considerable protection against the action of flux residues or condensing water.*

The conditions which will lead to condensation of appreciable amounts of water on zinc surfaces involve (a) a humid atmosphere and (b) cooling of the metal surface below the temperature of the surrounding air. For instance, if a large mass of metal is stored in an unheated building, the temperature of the metal can fall considerably during the night. If, next morning, warm air of high humidity comes into contact with the metal, much condensation will occur. This is observed in practice when on misty or foggy mornings condensation appears on metal stored in buildings partly open to the outside atmosphere. If metal is stored in a room which is not affected by outside humidity changes, there is much less chance of condensation on the metal. If a room containing warm air is cooled by conduction through the walls there is likely to be much more condensation on the walls than on the metal inside the room. In such circumstances it is, however, possible for condensed water to run from the ceiling or the walls on to the stored metal, and so produce white rust.

In the experimental work described it has not been found possible to produce large amounts of white rust inside coils of wire by causing condensation, or by the action of acid vapors including those from insulating tape. Only when bundles of wires were actually dipped

in distilled water was white rust produced in the interior. It therefore appears that for severe corrosion to occur in the interior of coils it is necessary for water to penetrate inside. The circumstances in which this may happen in practice may be rather critical, and a number of factors would affect the issue. Possible causes may be:

(i) Flux or electroplating residues on the wires; (ii) coils so loosely wound that water condensed on the outside easily runs into the interior; (iii) exposure in atmospheres highly contaminated with sulphur dioxide; (iv) coils of wire not properly dried before winding.

Of three practical instances of white rusting which have been investigated in recent years, one was due to rain-water, one was probably due to sulphur dioxide in the atmosphere, and one may have been due to condensation. In view of the small number of practical cases examined, however, it is not possible to say which of the various factors mentioned in this paper are the most important in practice.

References

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2. F. R. Morrall, *Trans. Electrochem. Soc.*, **1940** **77**, 279.
3. W. Feitknecht and R. Petermann, *Korrosion u. Metallschutz*, **1943**, **19**, 181.

EXPERIMENTS IN CHROME PLATING FROM NON-AQUEOUS MEDIA

(Concluded from page 49)

ide were found sufficiently soluble for study. Plating attempts were made at 50°C., 100°C., and 125°C., with and without sulfuric acid addition. In no case was a plate obtained.

Summary

Although hexavalent chromium ion is presumably necessary for chromium plating from aqueous solution, it has been determined that chromium will deposit from the trivalent ion in some non-aqueous solvents more effectively than from the hexavalent ion.

The conductivities of the non-aqueous solutions are generally low as compared to aqueous systems; current densities of from 5 to 15 amps./dm.² are necessary to give satisfactory deposits.

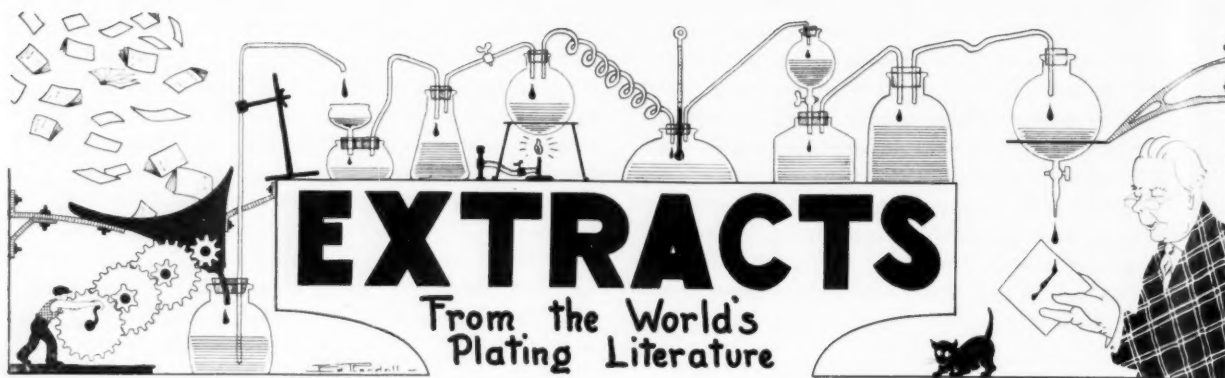
Of the solvents tried, the following were found to be the most satisfactory: formamide, acetamide, acetamide-urea mixture; less satisfactory were acetic acid and ethanalamine; giving very little success were dimethylformamide and acetonitrile.

The effect of adding a little sulfuric acid to the plating bath was to increase markedly the conductivity but otherwise not to affect appreciably the plating results when trivalent chromium was used; with hexavalent chromium the sulfuric acid improved results somewhat.

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*In practice it is necessary to rinse articles after chromating to avoid yellow stains. Care must be taken to prevent mechanical damage to the chromate films (particularly before they are dry) and they should not be heated to temperatures above about 70°C., if optimum protection is to be obtained.



Metallizing on Glass and Plastics

Anon—*Metalloberflaeche*, vol. 4, No. 1, pp. B9-B11.

A critical consideration is given of the relative merits of the normal ammoniacal-silver nitrate reducing solutions, including the *Brashear* Process; this process operates with ammoniacal silver nitrate solution containing caustic soda; Invert sugar which is used as the reducing agent, is prepared from cane sugar by the action of nitric acid. Prepared in this manner the content of oxidized compounds present accelerate the reducing action. The effectiveness is increased by additions of potassium-antimony tartrate and salts of nickel, chromium, copper, lead or zinc. A harder, tougher, and more corrosion resistant film is obtained.

With the triethanolamine process, various amino-alcohols are used as the reducing agent, such as mono-di- or triethanolamine, butyl or propyl amine, together with a neutral or weakly acid silver nitrate solution.

The newer solutions employing accelerated strongly reducing compounds are then considered, such as hydroxylaminesulphate, nitrate, hydrate or hydrochloride, glyoxal or hydrazine sulphate. This solution allows the use of a spray gun application. The required amount of ammonia may be added to the reducing solution.

Post-treatment of the film is applied either with the object of improving the adhesion of the silver film, for example, by use of a solution of gelatine in a 3% caustic soda solution; or else the film may be prepared for subsequent plating by immersion (5 seconds) in a solution of potassium mercury cyanide (0.04%). The reflective power of silver films is 98% with the *Brashear* process and 92% with the Rochelle salt process. The formaldehyde process gives darker films. Pretreatment with tin chloride reduces the reflective power, especially with the *Brashear* process. Silver alloy films, such as silver-copper and silver-platinum may also be produced.

For producing copper films, by the reduction of salt solutions of copper complexes, small additions of silver or other noble metals are made to act as catalyzers. Gold films are obtained by the reduction of a solution of gold chloride by a mixture of citric acid and ammonia or of an alkaline gold solution by glycerine-mannite solution.

For plating on films made conductive by silver mir-

ror surfaces prepared as above, baths must be employed in the initial stages which do not attack the film and only small currents can be used; for coppering, a not-too concentrated acid copper bath with very low sulphuric acid content or the Rochelle salt bath can be used. Nickel baths must give a stress-free deposit so as not to strip the silver mirror. In the case of mirror production, the silver film is given a nickel flash before strengthening the plating in the copper bath; otherwise the copper color would show through the silver film.

Detailed formulations and data regarding application are given with all the numerous baths described above.

Alkaline Degreasing Practice

R. Justh—*Metalloberflaeche*, vol. 4, No. 5, pp. A72-A76.

To insure an effective degreasing effect it is essential that the dirt and grease to be removed should form a suspension emulsion with the degreasing agent. The stability of this emulsion depends on the absorptive power of the degreasing agent at the boundary surface oil-water and is facilitated by minute particles (micels) of the same electrical charge. The cleaning effect of an alkaline degreasing agent is improved by the addition of small amounts of colloidal materials. The factors influencing these various phenomena are discussed at length.

A series of experiments were conducted by means of which it was demonstrated that a mechanical or scouring effect respectively will often serve to destroy again a fat emulsion which has already been formed and this will give rise to fouling of the cleaned metal surface.

The advantages and disadvantages of the various alkaline degreasing agents available are discussed; finally electrolytic-alkaline degreasing is critically considered. It is customary to add small additions of soap to the degreasing bath which serves to promote and facilitate the wetting effect and to provide a certain foam and emulsifying effect. The disadvantage of soap additions in an electrolytic alkaline degreasing bath is that the material is decomposed by the effect of the current and additionally with hard water it is almost

entirely precipitated as calcium and magnesium soaps. This may give rise to a spotting-out and staining effect, but particularly objectionable is the formation of cloudy suspensions in the bath, which with subsequent bright nickel or bright silver plating respectively — will become unpleasantly noticeable in their effect on the coating. They build a thin film which is scarcely visible which cannot be removed by acids. For matt silver or nickel plating these scum clouds have no practical adverse effect.

The sulphonated fatty alcohols serve to avoid this danger. Discussing the chlor-sulphonates of the fatty alcohols, the author mentions the "Igepon" series of the I. G. Farbenindustrie. They are characterized by outstanding stability in contact with mineral acids and alkalies, and lime salts. Mention is then made of the Sulfohalogenides (Mersoles) and their saponification products (Mersolates). They are obtained by the treatment of paraffin with sulphurous acid and chlorine. The Mersolates have a high cleansing efficiency. The foaming power of this cleaning agent is very high.

New Grinding and Buffing Process

Some interesting details of a new process for grinding, buffing and polishing were given in a paper by A. Burkhardt, being a new process developed at the German *Wuerttemberg Metal Works*. This may be regarded as a new and pioneer process in the field of finish buffing and polishing, and fine surface finish grinding. With this revolutionary process, the revolving work-piece holders dip, with the components to be finished, into the abrasive grinding or polishing powder, which is shown by centrifugal force against the cylindrical wall of a very rapidly revolving drum, which is open at the top. In this way, a very beautiful finish grind or buffing is given to the components parts in the shortest possible time and the process is also of particular value in the causes of those components which for one reason or another are difficult to grind or buff by ordinary methods.

Pickling and Pickling Acids

W. Savelsberg—*Metalloberflaeche*, vol. 4, No. 1, p. B-12.

During experience as a consultant in metal pickling plants, the author has observed that normal pickling solutions give a craterlike (pock-marked) appearance to the metal surface and in the hollows of this fitted surface, slag-like inclusions are present. The pickling of ferrous articles is considered, in which surface grinding or polishing before coating is not possible, but reliance is placed upon a vigorous cleaning by pickling. Sulphuric acid which is generally used for pickling will dissolve oxide and scale but not any slag inclusions on the ferrous surfaces. As these slag and oxide surface inclusions act noble to a ferrous surface, there is danger after subsequent coating by plating or galvanizing, of corrosion occurring from this cause.

Hydrochloric acid is much more effective as a pickling acid, and in spite of certain disadvantages, such as greater expense, the certainty of obtaining a cleaner

surface condition, free from slag inclusions for example, far outweighs this. Hydrochloric acid becomes more effective still in the pickling bath if ferric chloride is added. A composition of 5% of FeCl_3 to a 10% solution of hydrochloric acid has been found from practical experience to make a very effective pickling bath.

A case history is given of brass plated-on steel hair clips. Dark spots could be seen on the steel articles with the naked eye and under the microscope these were seen to be slag spots. A test batch each of the steel hair slides were pickled respectively in (1) 10% sulphuric acid, (2) in 10% hydrochloric acid and (3) in 10% hydrochloric acid with addition of 5% FeCl_3 (ferric chloride).

After 5 minutes pickling, the hair clips were rinsed, degreased in caustic soda and then brass-plated for 15 minutes in a potassium cyanide bath. Examination of the clips under the microscope after pickling had already shown that the slag inclusions of the clips pickled in sulphuric acid had not been appreciably attacked and with the hydrochloric acid bath, the slag inclusions had been removed both with and without the ferric chloride addition.

Corresponding to the above facts, on the brass-plated clips, spots could be seen on the (a) pickled samples, on the brass coating and flaws could also be seen in the plated coating under the microscope. The clips pickled (b) with hydrochloric acid showed a fairly satisfactory fault-free brass coating. The best plated surface appearance was however shown by the clips pickled with the ferric chloride addition; the brass plate was perfectly smooth and free from spotting.

Chemical Coloration of Art and Domestic Ware

By H. Krause—*Metalloberflaeche*, B. vol. 3, No. 1, B1-B3.

After detailing the various classified methods of the coloration of metal surfaces the author considers in detail the formation by artificial means of patina (basic copper carbonate) on copper surfaces. Copper articles which have been buried in the ground however show a different coloration from the normal malachite and this coating is found to consist of basic copper chloride and corresponds in composition to the mineral Atacamite $\text{CuCl}_2 \cdot 3 \text{Cu}(\text{OH})_2$ and is of a leek-green to dark color. The patina coating of copper roofs has been found to consist mostly of basic copper sulphate. Mention was then made of a further green copper patinate, basic copper acetate which is obtained with the use of many of the patent copper coloring preparations on the market. This is not so good in appearance and somewhat greener in color than true copper patina. Copper nitrate is also frequently used for the preparation of an artificial patina on copper. The coating produced has no chemical relation to the natural patina, but the salts acts very actively and rapidly produces a very beautiful patina which consists of basic copper nitrate. This coating has a very good covering power which can be ascribed to the platelike crystal structure. Basic copper carbonate has a granular structure, and the basic sulphate and acetate a needle-like structure.

Latest National Production Authority Rulings Affecting The Electroplating Industry

Since this article was written there has been a further amendment to Copper Order M-12, whereby Lists A and B have been revised to include additional prohibited items. See Amendment of March 9, 1951, complete details of which will be in the May issue. —Ed.

Nickel

NPA Order M-14

(As amended Feb. 28, 1951.)

The latest amendment to the nickel orders took effect on Feb. 28, 1951. While prior to this amendment users of nickel were not allowed to nickel plate restricted items which were started after March 1st and which had to be completed before April 30th, this new amendment extends the cut-off date so that manufacturers may nickel plate as long as their supplies of nickel hold out, provided that their inventories of nickel and nickel salts are not suitable for use *by them* on more essential items. This means, presumably, that so long as a plant does not have defense work, but does have a supply of nickel, it can continue to use this nickel for plating any of the items on the restricted list.

Nickel anodes used in the above manner *must have been in the inventory of the plating firm on March 1st*. Nickel supplies received in the plating plant later than March 1st cannot be used for plating items on the restricted list. Accurate records of all transactions in nickel are essential, and must be kept for two years for possible inspection by NPA.

See March issue of *Metal Finishing* for the complete list of items on which nickel plating is prohibited subject to the above revision.

Copper

NPA Order M-12

(As amended Feb. 19, 1951.)

This amendment is similar in effect to the above ruling on nickel, as it extends the period in which copper inventories may be used in the production of restricted items. A clarification on the use of copper plating as an undercoating is also made in this amendment.

Copper in inventory as of March 1st may be used to produce items on List A (see February issue of *Metal Finishing* for complete List A), subject to the % regulations on total usage, as long as the copper cannot be used in that plant on more essential items. Copper not in the plant's inventory, but ordered and on the producers schedule for February and delivered before April 1, can also be used in this manner.

A new list of restricted items (List B) has been added. Copper may be used in the production of items on this list after April 1, provided that the copper was held in inventory of the manufacturer as of April 1, or if the copper was on order and scheduled by the producer for March and delivered not later than May 1, 1951, provided it cannot be used in more essential items.

The use of *brass plating* is permitted on all items of builders hardware where other types of finishes are not practicable. Copper or copper-alloy plating may be used on any item on Lists A and B, or any component part thereof, *where such plating is an undercoat for chromium, nickel, gold, or silver, or for brazing any item or component of items on the lists*. Percentage limitations on total usage are still in effect.

List B

BUILDERS' HARDWARE

Protective brass plating of all listed items of builders' hardware is permitted where other types of finishes are not practicable.
Door knobs.
Letter slots.

BUILDING MATERIALS

Facias. Fittings for underfloor raceway systems.
Flashings (except (1) cap and base flashing for built-up roofing, (2) through-wall flashing in parapet walls, (3) flashing for chimneys, vent stacks and all other vertical surfaces rising through roof levels, (4) roof-to-side wall flashing, (5) valley flashing for slate, tile and cement shingle roofs, (6) door and window head flashing, (7) expansion joint flashing).

Gravel stops.
Shower pans.
Terrazzo strips.

CLOTHING AND DRESS ACCESSORIES, NOT INCLUDING SAFETY EQUIPMENT

*Slide fasteners (zippers) (except (1) for functional components such as slider bodies, separating end-components and top and bottom stops; and (2) except for applications in safety garments, work clothing, rubber footwear, foundation and surgical garments where necessary for reasons of strength, launderability and anti-corrosion).

FURNISHINGS AND EQUIPMENT

Refrigerator and water heater installation connections (except for high pressure LPG connections from tank to fixture).

FURNITURE AND FIXTURES

Fittings (except hospital and laboratory).

HARDWARE, MISCELLANEOUS

Tags for pets.

HOUSEHOLD ELECTRICAL APPLIANCES

(Except for operational parts where the properties supplied by the copper are essential or where necessary for electrical conductivity.)

Coffee makers.
Home and farm freezers, including the "low side" refrigerant circuit.
Ice cream freezers.
Waffle irons.

REFRIGERATION AND AIR CONDITIONING MACHINERY AND EQUIPMENT (Commercial and Industrial)

(Except where copper products or copper

base alloy products are essential for the following: carbonators, complete condensing units less condensers, dehydrators, draft arms for soda fountain equipment, electrical controls and wiring, fittings, protective coatings, refrigerant circuits (except in condensers for open-type air cooled condensing units and evaporative condensers for freon refrigerations or air conditioning circuits for ice cream cabinets, frozen food cabinets, and "wet type" bottled beverage coolers), refrigerant connections between compressor and cooling coils, refrigerant flow control valves, sight glasses, soldering and brazing materials, strainers, suction line heat exchangers, tube sheets, valves, water cooler low sides and pre-coolers, water flow control valves and water spray nozzles for evaporative condensers, evaporative coolers, and air washers.)

Commercial and industrial refrigeration and air conditioning machinery and equipment including but not limited to:

- Air conditioning systems, self-contained or remote.
- Air washers.
- Blast coolers.
- Blast freezers.
- Bottled beverage coolers.
- Carbonated beverage dispensing systems (except coin operated).
- Compressor stop valves (except valve seats, gaskets, bonnets, discs, disc screens, and protective coverings for valve stems).
- Evaporative condensers.
- Evaporative coolers (desert type).
- Finned air-cooled condensers except those used for hermetic systems where the condenser is exposed to the outside air or for transportation systems.
- Finned coils or evaporators.
- Florist refrigerators.
- Fountainettes.
- Frozen food cabinets.
- Ice cream cabinets.
- Ice cube makers.
- Malt beverage dispensing systems.
- Mortuary refrigerators.
- Non-carbonated beverage dispensing systems (except coin operated).
- Reach-in refrigerators.
- Refrigerated display cases.
- Refrigeration systems, self-contained or remote.
- Reverse cycle heating and air conditioning systems (heat pumps).
- Sandwich units.
- Shell and tube or shell and coil condensers.
- Shell and tube or shell and coil water chillers.
- Soda fountains.
- Space coolers.
- Unit coolers.
- Walk-in refrigerators.
- Water coolers, except bubblers and bubbler connections.

MISCELLANEOUS

- Dehumidifiers for home and office use.
- Flashlight cases (except contact points for carrying current).
- Ball point pens (except necessary operational parts).
- Hollow ware (except for hotels, restaurants, institutions and ecclesiastical use).
- Identification and directional signs (except current-carrying parts).

- Outboard motors (except for operational parts).
- Portable electric lanterns, such as railroad, miners' and industrial (except parts for conducting electricity and for plating).
- Shells and caps for sockets.
- Ties (except for explosives and other products where the properties supplied by copper are essential).

DO Symbols

The National Production Authority, U. S. Department of Commerce, has made public the list of DO (defense order) symbols used at the present time in rating orders for production under the mobilization program.

The DO-rating system is a single-rating band, and NPA regulations require that all DO-rated orders be

filled in advance of non-rated orders. Many materials and products needed for the defense program are in short supply, and the purpose of the single-band priorities system is to assure that defense and defense-supporting production has the right of way.

The two-digit code numbers assigned to the various DO ratings are purely for purposes of identifying the program to which the order is related, or the claimant agency, and *do not indicate any preference*, NPA emphasized. Rated orders are to be accepted in the order in which they are received.

The code numbers assigned to the various programs, subject to change from time to time, are as follows:

DO CODE NO.	AGENCY PROGRAMS	MAJOR PROGRAM INVOLVED
01	Department of Defense	Aircraft
02	" "	Guided Missiles
03	" "	Ships
04	" "	Tank-Automotive
05	" "	Weapons
06	" "	Ammunition
07	" "	Electronics and Communications Equipment
08	" "	Fuels and Lubricants
09	" "	Clothing and Equipage
10	" "	Transportation Equipment
11	" "	Building Supplies and Equipment For Overseas Construction
12	" "	Subsistence
19	" "	Production Equipment
21	" "	Miscellaneous
22	" "	Contract Construction
35	Economic Cooperation Adm.	Foreign Additional Military Production
36	" " "	Foreign non-Military Production
37	Office of International Trade	Foreign Production (other than E.C.A. non-Military)
40	Atomic Energy Commission	Operations
41	" " "	Construction
42	" " "	Construction Equipment
43	" " "	Privately Owned Complete Facilities
44	" " "	Privately Owned Facilities Additions
45	National Production Authority, Civil Aeronautics Adm., and National Advisory Committee for Aeronautics	Miscellaneous
46	National Production Authority	Industry Plant Expansion
47	" " "	All Canadian Programs
48	Department of Interior	All Programs
49	Department of State	Voice of America
60	U. S. Coast Guard	Miscellaneous
61	" " "	Aircraft
62	" " "	Construction
63	" " "	Ships
97	National Production Authority (or delegatee)	Maintenance, Repair and Operating Supplies
98	National Production Authority (or delegatee)	Production Equipment for Certain Private Contractors
99	National Production Authority (or delegatee)	Basketing (Small orders bunched together under NPA Reg. 2)

(Digits 50 and 51 were formerly used by the National Advisory Committee for aeronautics. Digits 55, 56 and 57 were formerly used by National Production Authority for Canada.)

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Chrome Plating Directly on Copper

Question: We have a problem involving chrome plating directly over copper plating. We have run into difficulty in obtaining good adhesion of the chrome, and wonder if you can suggest a good method for doing this so that we can get good adhesion of the chrome deposit.

P. W. A.

Answer: There are several things which may be causing the poor adhesion. One would be the formation of thin chromate films on the copper if the parts are immersed for a few seconds in the chrome bath before the current is on. This can be overcome by having the work in contact with the cathode rod when the rack of parts is immersed. Flexible copper leads can be used to make the contact between the rack and the cathode rod. The rack must be immersed rapidly to avoid sparking.

Another cause of the trouble could be excessive reverse current cleaning of the buffed copper plating. This causes thin oxide films to form on the copper surface which prevent adhesion of the chrome. A short direct current cleaning treatment should be all that is required if preliminary cleaning in a vapor degreaser or emulsion cleaner is used to remove the bulk of any buffing compounds.

Cleanability of Drawing Compounds

Question: We have been investigating the effect of various cleaning methods in evaluating commercial deep-drawing compounds, and have

found that there is considerable difference in cleanability depending on whether the compound is allowed to stay on the parts for a period of time before cleaning or not. As such aging tests take too much time to be most useful, we are wondering if there is any test that we can make on the new drawing compound that may give a clue as to its cleanability after staying on the parts for a period of several weeks?

F. T. N.

Answer: The difference in the ease with which fresh and aged drawing compounds may be cleaned from metal parts is usually attributed to oxidation, acid and metallic soap formation, or polymerization of any unsaturated oils contained in the compound. A test for the amount of unsaturated oils would therefore seem to be a reasonable approach to this problem. The well known Iodine Number Test for oils could be used for this purpose. This is only a suggestion, and would have to be verified by actual aging and cleaning tests. There may be other components of the drawing compound that would be affected by drying out, etc., and contribute to the difficulty in cleaning after lying on the parts for long periods, in addition to the quantity of unsaturated oils present.

Filtering Cyanide Solutions

Question: I would like to filter my brass and silver solutions, and would like to know if it would be all right to use activated charcoal in the filter in order to get rid of some of the impurities in these solutions, such as results from buffing compounds, etc.?

N. J. F.

Answer: Filtering through activated carbon will be all right, but you should remember that it will also remove any organic brighteners present, such as carbon disulfide, etc. Names of firms that can supply suitable grades of carbon are being forwarded to you. If any contamination from buffing compounds is getting into your plating baths it is a sure sign that your cleaning cycle is not adequate.

Cyanide Copper Plating from Cold Baths

Question: For certain purposes we are investigating the permissible temperature range in copper cyanide solutions at lower temperatures in order to find the critical temperature at which adhesion becomes poor. We have found a rapid decrease in adhesion at temperatures below 170°C., and decidedly bad adhesion at 10°C. We would like to know if there has been any work done in this field and what the results were, so we can verify our findings.

Answer: We have referred this problem to our genial friend and "Walking Encyclopedia of Plating Information," Mr. George B. Hogaboom, Sr., who has kindly supplied the following comments:

"The results would depend on the carbonate concentration of the solution and whether sodium or potassium salts were used. Sodium carbonate will crystallize out of the bath, and while there will be no actual precipitate of sodium carbonate at 10°C., there undoubtedly would be formed at the cathode surface a highly concentrated film having a high carbonate concentration which would cause polarization and subsequently poor adhesion. Potassium salts are not so easily crystallized out of the bath by low temperatures, and presumably should not cause as much trouble as the sodium compounds. Even with potassium salts, however, a "mushy" substance containing both

carbonates and cyanides will be formed at low temperatures."

Restrictions on Brass Plating

Question: We make brackets for metal curtain rods, and would like to know if we can continue to brass or nickel plate these items. We also make cup hooks, brass plated, and would appreciate knowing how these items are affected by recent Government rulings.
C. F. L.

Answer: NPA Order M-12, as amended Dec. 30, 1950, specifically forbids the use of brass plating on curtain fasteners, rods, and rings. While curtain brackets were not listed, they are similar enough to the above products to assume that brass plating would be forbidden on them also. The same comments would, we presume, apply to the cup hooks, inasmuch as such items as hooks and eyes, upholsterers supplies, etc., are forbidden items for brass plating.

For specific information on any given item, we suggest that you contact your nearest local NPA office. A complete list of these was given in the February issue of *Metal Finishing*, pages 93-94.

Steel Anodes for Chrome Plating

Question: We have been told that the use of steel anodes in a chrome plating tank produces better finishes than does lead anodes. One plant that we know of has been doing this for some years, as they claim that the troublesome cleaning of lead anodes is eliminated in this way. Can you give us any information on such an application?

C. L. O.

Answer: Steel anodes in a chrome solution would be rapidly dissolved with resulting iron contamination of the bath. Even stainless steel anodes are not suitable. Proper use of lead anodes should not result in any troublesome cleaning problems. If the bath is not operated every day the lead anodes can be lifted out of the tank to prevent excessive film build-up. The oxide coating which forms on lead anodes helps to reduce the trivalent chrome build-up also, which would not be true of the steel anodes. There is no reason to expect any better plat-

ing results from iron anodes than from lead alloy anodes.

Uneven Anode Solution

Question: For some time we have noticed that the anodes in our cyanide zinc plating solution seem to dissolve at widely different rates. Normally we expect that the anodes nearest the center of the tank would dissolve most rapidly, but this does not seem to be the case. Some of the center anodes show hardly any corrosion, while some of those at the far ends of the tank are almost entirely eaten away. They were all placed in the tank at the same time, and we believe they all came from the same shipment. This problem does not seem to affect our plating results, but

we would like to know what may be causing the trouble, if possible.

W. R. L.

Answer: Inasmuch as the anodes seem to be from the same lot (but not necessarily of the same analysis or crystalline structure), it is probable that differences in purity and grain structure are not factors in this case. Your trouble most likely lies in the contacts of the anodes with the anode rod. Hooks and rods can easily become coated with chemical deposits that insulate the anodes from the current source. Cleaning the underside of the hooks where they make contact with the anode rod, plus cleaning of the anode rod itself, will clear up this type of trouble.

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PATENTS

Gas Plating Inside Hollow Tubes

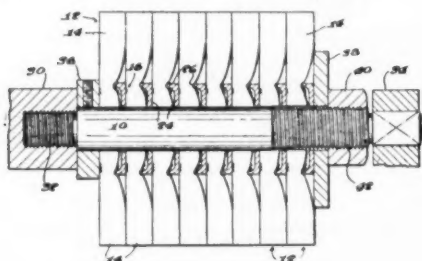
U. S. Patent 2,516,058. J. J. Lander, assignor to Bell Telephone Laboratories, Inc.

Apparatus for plating the interior of a hollow tube with metal comprising an elongated structure introducible into the entire length thereof, means for circulating a cooling fluid through the structure, means for supplying gas including gas of a metallic carbonyl into the structure, said structure comprising a plurality of outlet means distributed over substantially the entire length thereof for supplying the gas supplied thereto to the interior surface of the metallic tube to be plated, and a plurality of outlet means distributed over substantially the entire length thereof and leading to an outlet passage for removing said gas from the interior surface of the tube to be plated, a vacuum pump attached to said outlet passage, said structure when introduced into the hollow tube to be plated being sealed thereto to exclude all gases except those introduced intentionally along with the metallic carbonyl vapor.

Buff Design

U. S. Patent 2,522,092. G. R. Churchill.

As a new article of manufacture, a buffing wheel comprising an arbor, a plurality of individual buffing wheel sections mounted upon the arbor, each section comprising a closed ring of connected and radially extended cloth buffing elements, separate clinching collars interposed between adjacent buffing wheel sections on the arbor, and means for clamping the assembled unit upon the arbor to clamp the sections between adjacent collars, each of said clinching collars comprising a flat circular disc having a laterally extended continuous flange at its outer periphery arranged to press without piercing into the buffing material be-

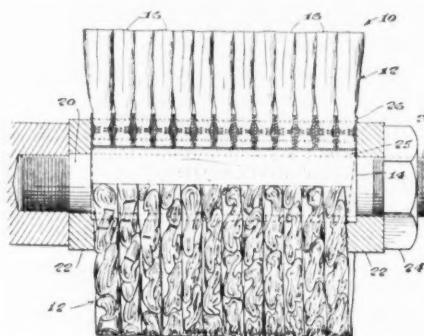


yond the line of connection of said buffing elements, said individual buffing elements being detached and free to flex with relation to one another during the buffing operation at all points beyond the periphery of said circular disks.

Buff Design

U. S. Patent 2,522,093. G. R. Churchill.

A cylindrical buffing roll of substantial length adapted in use to be rotated about its axis, said roll comprising an arbor and a continuous elongated strip of connected cloth buffing elements wound helically and with a substantial lead about the arbor equal at least to the normal uncompressed thickness of the strip, each element comprising a relatively narrow multiply assembly, said strip presenting the buffing elements in a radial direction to form the cylindrical buffing roll, and means for securing said strip to the arbor including end collars shaped to

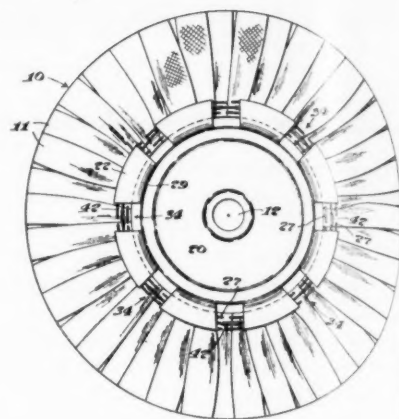


correspond to the ends of the buffing roll for causing the strip to assume a helical shape as it is being wound around the arbor and for maintaining the strip in such shape, whereby during the buffing operation the work is successively brought into contact with portions of the surface of the roll of varying density, thus eliminating streaking of the work.

Buff Design

U. S. Patent 2,522,094. G. R. Churchill.

A multi-section buffing wheel comprising a plurality of buffing wheel sections, a spindle on which said sections are mounted and a plurality of spacing members between adjacent sections, each of said buffing wheel sections including a flat circular plate mounted on the spindle and a ring of radially-extended buffing elements secured at their inner ends to one side of said plate and terminating a substantial distance from said spindle, said spacing



members being provided with rim portions engaging the opposite lateral face of the inner end portions of said radially extended buffing elements and provided with a central portion disposed within the circular opening formed by said ring of buffing elements and shaped to form an air chamber between one face of the spacing member and supporting plate of an adjacent buffing wheel section, said spacing members being also provided with air ports for conducting air into and from the air chamber at the rim section of said spacing members.

Bright Nickel Bath

U. S. Patent 2,523,190. H. Brown, assignor to The Udylyte Corp.

A bath for electrodepositing fine-grained, lustrous nickel consisting essentially of an aqueous acid solution of a material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, a mixture of nickel fluoborate and nickel chloride, a mixture of nickel fluoborate and nickel sulfate, a mixture of nickel sulfate, nickel chloride and nickel fluoborate, said solution also having dissolved therein an unsaturated organic compound selected from the group consisting of vinyl sulfonic acid ($\text{CH}_2=\text{CHSO}_3\text{H}$), chlor vinyl sulfonic acid and brom vinyl sulfonic acid, said unsaturated organic compound having a concentration in the bath falling within a range of from about 1 gram per liter to saturation.

Addition Agent for Cadmium Plating

U. S. Patent 2,523,432. R. O. Hull.

An aqueous cyanide-cadmium plating bath comprising from about 0.3 to 1.6 gram per liter of sulfonated cod oil.

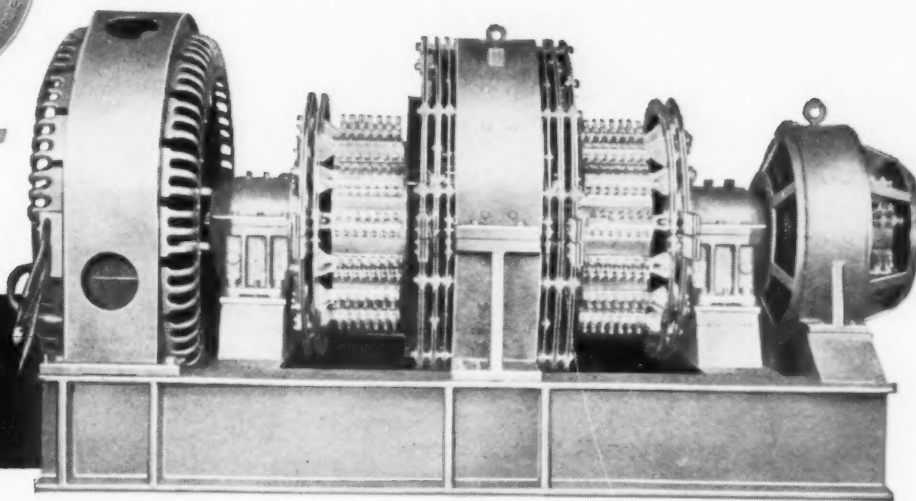


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For full details ask for Bulletin G-102.

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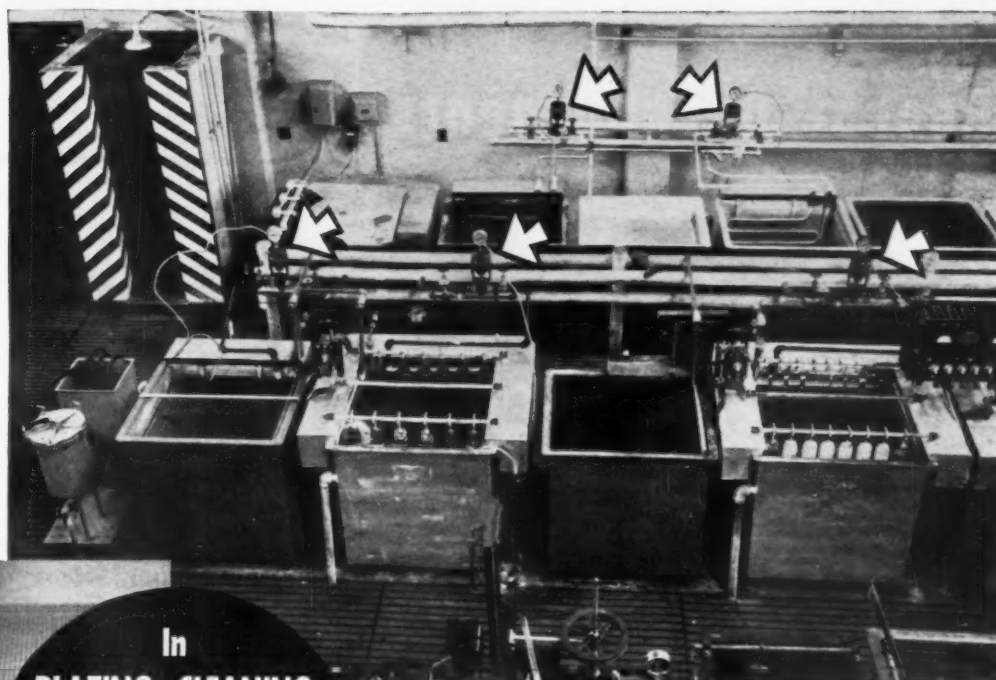
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Rod Size (in inches)	Square inches per inch of length	Square feet per foot of length	Square inches per inch of length	Square feet per foot of length	Square inches per inch of length	Square feet per foot of length
$\frac{1}{32}$	.0974	.00812	.124	.0103	.108	.009
$\frac{1}{16}$	.1944	.01623	.250	.0207	.217	.0181
$\frac{1}{8}$	.3928	.03273	.500	.0417	.433	.0363
$\frac{3}{16}$	.588	.04896	.750	.0623	.651	.0543
$\frac{1}{4}$	.786	.0655	1.000	.0833	.866	.0722
$\frac{5}{16}$	.980	.0817	1.250	.104	1.083	.0903
$\frac{3}{8}$	1.178	.0982	1.500	.125	1.302	.1089
$\frac{7}{16}$	1.373	.1144	1.750	.146	1.516	.1263
$\frac{1}{2}$	1.571	.1309	2.000	.167	1.732	.1444
$\frac{9}{16}$	1.766	.1471	2.250	.187	1.953	.1628
$\frac{5}{8}$	1.964	.1636	2.500	.208	2.165	.1806
$\frac{11}{16}$	2.161	.1801	2.750	.229	2.383	.1980
$\frac{3}{4}$	2.356	.1964	3.000	.250	2.598	.2162
$\frac{13}{16}$	2.551	.2126	3.250	.271	2.813	.2342
$\frac{7}{8}$	2.749	.2291	3.500	.292	3.031	.2523
$\frac{15}{16}$	2.944	.2453	3.75	.312	3.246	.2711
1	3.142	.2618	4.00	.333	3.464	.2890
$1\frac{1}{16}$	3.336	.2780	4.25	.354	3.681	.3070
$1\frac{1}{8}$	3.534	.295	4.50	.375	3.897	.3248
$1\frac{3}{16}$	3.729	.3107	4.75	.396	4.115	.3430
$1\frac{1}{4}$	3.927	.3273	5.00	.417	4.328	.3608
$1\frac{5}{16}$	4.122	.3435	5.25	.437	4.547	.3790
$1\frac{3}{8}$	4.320	.3600	5.50	.458	4.766	.3971
$1\frac{7}{16}$	4.515	.3762	5.75	.479	4.980	.4150
$1\frac{1}{2}$	4.712	.3927	6.00	.500	5.196	.4330
$1\frac{9}{16}$	4.907	.4089	6.25	.521	5.417	.4514
$1\frac{5}{8}$	5.105	.4254	6.50	.542	5.629	.4691
$1\frac{11}{16}$	5.303	.4419	6.75	.563	5.847	.4873
$1\frac{3}{4}$	5.498	.4581	7.00	.583	6.062	.5051
$1\frac{13}{16}$	5.693	.4744	7.25	.604	6.277	.5231
$1\frac{7}{8}$	5.891	.4909	7.50	.625	6.495	.5413
$1\frac{15}{16}$	6.085	.5071	7.75	.646	6.710	.5592
2	6.283	.5236	8.00	.667	6.928	.5780

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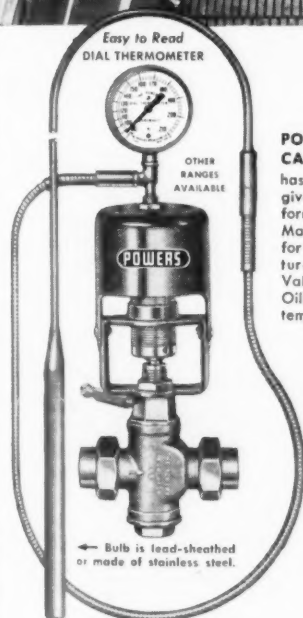
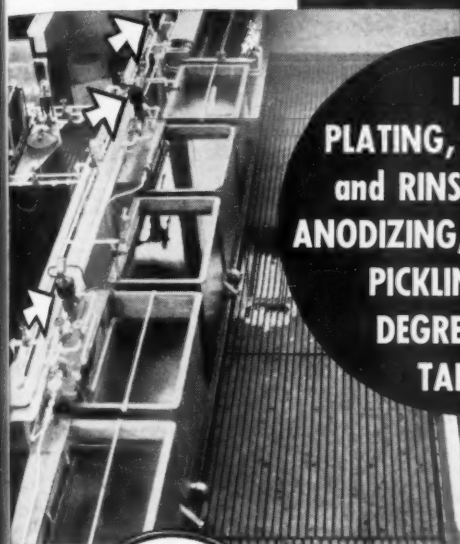
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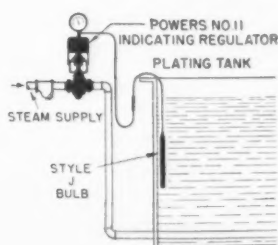
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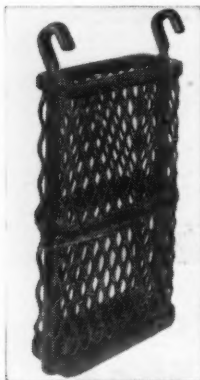
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Scrap Anode Basket

*Belke Manufacturing Co., Dept. MF,
947 N. Cicero Ave., Chicago 51, Ill.*



An improved, heavy-duty scrap anode basket that gives longer service has been developed by the above firm. The anode baskets are constructed of heavy gauge expanded steel welded to a frame of 3/16 x 1" steel members. Bands

on sides and bottom of basket and hooks are of one continuous 3/16 x 1" steel piece to give maximum strength to frame.

An extra heavy coating of Belke Universal Plastic is claimed to provide positive protection from sharp anode scraps and rough handling, and to withstand all plating solutions.

All baskets are made to specified dimensions, and filter bags can be furnished for baskets of any size.

Complete information furnished on request.

Soluble Potassium — Silver Cyanide

*Sel-Rex Precious Metals Inc., Dept.
MF, 229 Main St., Belleville, N. J.*

A new chemical product, Sel-Rex silver plating Sol-U-Salt of particular interest to all those engaged in silver plating, has been announced by the above firm. Sel-Rex silver plating Sol-U-Salt is a pure, white, crystalline, free flowing salt of known and definite chemical composition. It is used to make up new silver cyanide plating solutions or for metal replenishment.

Among the many advantages of this new product are:—

1) No harmful ingredients are introduced to the plating solution because of the high purity of this double salt.

2) It is added directly to the plating bath without filtering as it is free of residues of any kind.

3) It does not affect the free cyanide content of the plating solution.

4) It eliminates waste, hazard and expense of handling dusty, readily-airborne powders common in silver plating operations.

5) It permits convenient calculations, as 2 ounces avoirdupois of potassium silver cyanide contains 1 troy ounce of metallic silver.

6) It eliminates rough deposits caused by insoluble residues.

7) It is packed in plastic bags which can be removed from the outer container so as to eliminate all waste or contamination.

In the short time in which this material has been on the market, it has met with wide acceptance for all types of silver plating, both ornamental and defense uses, it is claimed.

New Coatings for Zinc and Steel Simulate Copper, Brass, Bronze

*Maas & Waldstein Co., Dept. MF,
438 Riverside Ave., Newark 4, N. J.*

One solution to the unavailability of copper, brass and bronze for fabricating or plating purposes has been found through the development of special surface coatings, according to the above firm, manufacturers of industrial finishes.

Known as Platelustre, the new finishes are said to closely simulate the appearance of copper, brass and bronze when applied over zinc, steel or zinc-plated steel, and are claimed to have satisfactorily withstood 800 hours salt spray and weatherometer tests. Platelustre is available for both air-drying and baking schedules.

Platelustre is expected to be of particular interest to the makers of such products as lipstick shells, compacts, builders' hardware, lamps, and similar items in which the public has come to expect the familiar appearance of copper, brass and bronze.

Full information about Platelustre

may be obtained by request on company letterhead.

Corrosion Resistant Wax

*S. C. Johnson Co., Dept. MF, Racine,
Wis.*

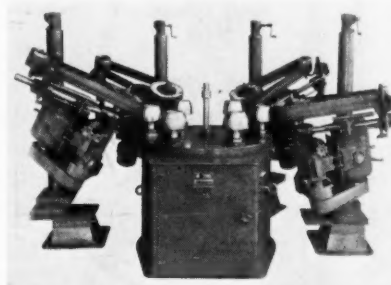
A new, non-toxic, corrosion inhibiting wax has been developed by the above firm.

It can be applied by conventional dips, spray or brush methods to all types of metals. When removal is necessary, a standard vapor degreasing operation is used.

During World War II, Johnson's manufactured a number of corrosion-inhibiting waxes which were used on many war materials including machine gun parts, shovels, picks, axes, tools and wrenches, cutting knives and meat saws, aeronautical instruments, steel molds, cores, die blocks, snaps and buckles for parachutes, parts for planes, jeeps, and tanks and many others. These waxes provided a shop coating that was not easily removed by handling and not soaked away by contact with absorbent packing materials.

Universal Belt Polishing Attachment for Automatics

*Acme Mfg. Co., Dept. MF, 1645
Howard St., Detroit 16, Mich.*



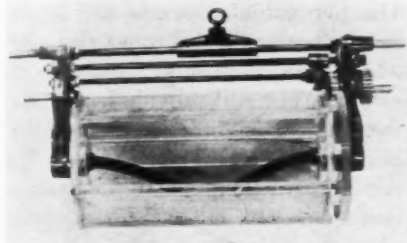
A newly developed polishing belt arm attachment which is universally adjustable from horizontal to vertical positions has proved unusually effective in a new 40 inch rotary automatic polishing and buffing machine arrangement developed by the above firm.

The machine shown is a six-station indexing rotary, with 4 Acme type G-1 adjustable floating head buffing lathes equipped with the new polishing belt arm attachment. It is used for polishing automotive grille parts. With this attachment the Acme G-1 and G-3 lathes are readily converted to polishing belt heads.

The machine illustrated has one-second indexing interval, the same as all Acme indexing rotaries, and can be furnished with many other features such as geared chucks, oscillating arms, automatic-locking tail stocks, vacuum chucking, and special fixtures. Stroking spindle arrangement for longer belt life, vertical power traverse, reciprocative actions and air lift can also be provided with these Acme arrangements.

Plexiglas Plating Cylinder

Hanson-Van Winkle-Munning Co.,
Dept. MF, Matawan, N. J.



The above firm announces the development of a new cylinder, for barrel plating, made of Plexiglas. The illustration shows a 14" x 30" o.d. cylinder with rubber covered hanger arms and flexible dangle contacts.

Plexiglas is suitable for either cyanide or acid solution, and can be carried through the entire cleaning, pickling and plating cycle. Where cyanide solution is involved, the cylinders will be equipped with 90-tooth cast iron gears with both hangers of cast iron. Cast iron hangers are recommended for cadmium, cyanide copper, BBZ-200 Zinc or any other alkaline or cyanide bath. Where the cylinder is used in an acid solution such as nickel, or carried through the entire cleaning and pickling cycle, 90-tooth Merlon or Plexiglas gears will be supplied and the hanger arms will be of cast iron, rubber covered.

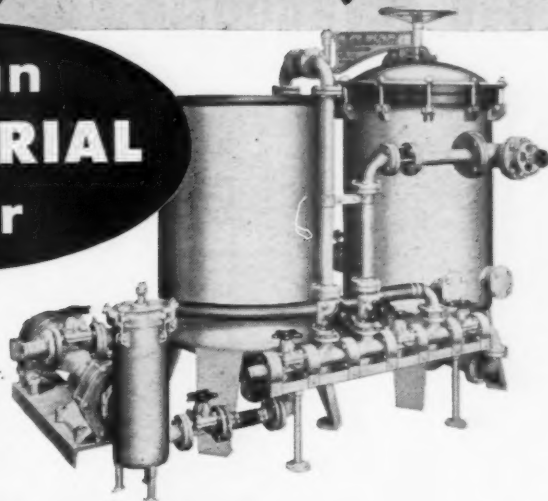
Only high temperature Plexiglas, satisfactory for temperatures of 185 degrees F. is used and the cylinder is guaranteed to stand up under these conditions.

Plexiglas cylinders are furnished

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Filter**

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systems engineered to meet
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Here's how Industrial filters keep down the cost of plating jobs—The flow rates of Industrial filters are based on the actual plating solutions involved. You know the capacity you get. In the filtration of plating solutions there is more than just the filter. With Industrial you get an adequate filter with slurry tank, motor driven pump, valves and fittings in a complete package with one, undivided, experienced responsibility—with space requirements at a minimum.

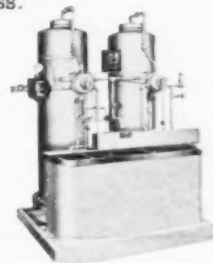
The labor, down time, and the inconveniences of cleaning, replacing the filter media, and reassembling the filter for every new filter cycle—all are eliminated by the Industrial Air-Wash Cleaning Method available for all models. It is necessary to remove the cover only when new filter cloths are installed. With Industrial filters, a clarified plating solution is always assured.

The engineering, design, and construction of Industrial filters have proved out in long service and low maintenance costs. Industrial has the experience and is large enough to handle your filter requirements. Since 1927 filters and filtration systems have been an important part of our business.

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F.S.



Wyandotte F. S.* is designed for heavy-duty electrocleaning. It is a reverse current electrocleaner of well-balanced formula, gets work chemically clean. Important, too, Wyandotte F. S. has long life in solution and contains ingredients for water conditioning and improved rinsing.

While F. S. is used primarily for the cleaning of ferrous parts, it is satisfactory for heavy-duty electrocleaning of copper, bronze and magnesium. We suggest you write us, at Wyandotte, for the Technical Information sheet on F. S.

*Reg. U.S. Pat. Off.

Owning its basic raw materials places Wyandotte in an especially advantageous position to maintain quality—supply large quantity needs consistently.

THE WYANDOTTE LINE—products for burnishing and burring, vat, electro, steam gun, washing machine and emulsion cleaning, paint stripping, acid pickling, related surface treatments and spray booth compounds. An all-purpose floor absorbent: Zorball. In fact, specialized products for every cleaning need.

PERFORMANCE CHARACTERISTICS

Wyandotte

F.S.

- Exceptional detergency for removal of fabricating oils and smut
- Excellent smut removal
- High conductivity for maximum gas scrubbing action
- Fast and complete wetting action
- Controlled foaming
- Proper conditioning of hard water
- Very free rinsing
- High soil suspension ability
- 100% solubility in water
- Outstanding solution life
- Controlled uniform quality

WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN

Service Representatives in 88 Cities



Wyandotte

REG. U. S. PAT. OFF.

with flexible dangler contacts, but hair-pin type dangler contacts or disc contacts can also be supplied if desired.

The hanger arm construction is said to represent a great improvement, especially on the rubber-covered arms. The rubber is durable and the trunion holes are rubber lined. This type of construction completely insulates the arms. Merlon trunions are pressed into the hanger. When the trunion needs to be replaced, all that is necessary is to press out the old trunion and insert the new one.

In the construction of Plexiglas cylinders, heat is applied to join the parts properly. The heads are 1" thick; panels 1/2" thick. The cylinders are hexagonal in shape with the inside ribs and cover held in place with the new "C" type clamp. Plexiglas cylinders can be repaired by the application of heat.

All parts are molded and are cemented together with Plexiglas cement. The five cylinder panels will be "V" shaped horizontally through the middle which will not only strengthen the cylinder, but will provide better tumbling action, as the point of the "V" is on the inside of the cylinder. With this construction, better tumbling action is secured and there is no danger of work sliding on panels.

With the flexible dangler contacts, all chances of treeing are eliminated and maintenance costs are greatly reduced. A number of Plexiglas cylinders have been in operation under actual production conditions for some time with excellent results, it is claimed.

Barrel Finishing Compounds

Almco Supersheen, Dept. MF, Albert Lea, Minn.

This firm has announced the development of three new compounds, available for immediate delivery, which represent further steps forward in the field of advanced barrel finishing.

COMPOUND #3

This compound contains a very aggressive abrasive and can be used with water. It is a replacement for the old "emery and oil" method of tumbling used for many years. Substantial savings are claimed possible by this compound through the replacement of oil with water. Advantages of this new abrasive compound are said to be fast cutting down, free rinsing, oxidation inhibition, improved color, rust pre-

vention and unusually low processing costs. Recommended for use in self-tumbling and also with the various abrasive chips. Speeds up the grinding operation and gives excellent surfaces for the adherence of paints or coatings, according to the firm.

BURNISHING COMPOUND #10

Especially designed to produce better burnished finishes than have heretofore been possible, this new compound prevents discoloration of work due to compound breakdown. It is claimed to produce a clean, free-rinsing surface with no fatty soap deposits which might interfere with subsequent electroplating operations. The new No. 10 contains ample water softeners, requiring no separate additives under hard water conditions, and prevents "loading" of chips or work with hard water precipitates or soil which so often prevent the production of high luster surfaces. This improved compound also produces a high head of suds which is said to be much longer lasting than the suds from the usual burnishing compound. A special advantage claimed for this new burnishing compound is that aluminum and stainless steel colors are protected during deburring and grinding cycles.

DESCALING COMPOUND #15

This new compound is slightly acid and has been designed especially for applications requiring quick descaling of steel parts. A great advantage claimed for No. 15 is that it descales, deburrs, and polishes simultaneously when used in combination with abrasive chips. Under actual operating conditions, it has been possible to replace an acid pickling operation, a sand blasting operation and quite often a grinding, burnishing or coloring operation with this new compound, according to the manufacturer. Effective with either cold or hot water, No. 15 leaves the work and chips clean and ready for the grinding, burnishing or coloring as required by the particular operation.

Packaged Water Demineralizers

Illinois Water Treatment Co., Dept. MF, 840 Cedar St., Rockford, Ill.

The above firm has recently announced a complete line of "package-type" units ranging in size from 12 to 1,000 gallons per hour. Larger units can be engineered to meet specific requirements. The series includes six

BRIGHT FINISHING SYSTEM

SPARKLES

LIKE CHROME!

Leading manufacturers approve zinc plate

and **IRIDITE** Bright

to replace conventional chrome plating

If your problem is finding the right finish to replace conventional chrome plating, follow the lead of prominent manufacturers of all types of products . . . switch to zinc plate and Iridite Bright.

Here's what you get when you use this chromate finishing system to replace conventional chrome plating.

SPARKLING BRIGHT APPEARANCE

The zinc plate and Iridite Bright system resembles chrome so closely that visual inspection can scarcely tell the difference! And, the brilliance lasts.

BETTER CORROSION PROTECTION

Yes, you actually get better protection with zinc plate and Iridite Bright than with chrome plating . . . up to twice the life under accelerated salt spray conditions! And, by applying a clear baking lacquer over the Iridite coating you can increase the abrasion resistance and lasting qualities of this bright finishing system, at the same time making possible a greater salt spray protection.

LOWER FINISHING COSTS

One metal, zinc, replaces three so you save material costs and plating time. Iridite Bright goes on in a non-electrolytic chemical dip.

Write or call today for your copy of our new Technical Bulletin describing all phases of this bright finishing system in detail. Tell us your bright finishing requirements. If possible send sample parts for test processing.



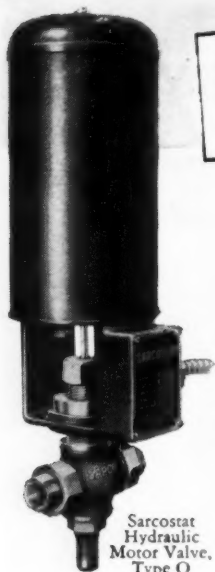
Iridite is approved under government specifications

ALLIED RESEARCH PRODUCTS

INCORPORATED

4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

REPRESENTATIVES IN PRINCIPAL INDUSTRIAL CITIES; West Coast: L. H. BUTCHER COMPANY
Manufacturers of Iridite Finishes
for Corrosion Resistance and Paint Systems on Non-Ferrous Metals; ARP Plating Chemicals.



Sarcostat Hydraulic Motor Valve, Type O

Better Valves

for the Metal Finishing Field

At last a powerful, electrically operated control valve which does not depend on pilots, gear trains or levers.

The new Sarcostat, type O, is actuated directly by oil pressure on a plunger hermetically sealed in an oil chamber. A 1/100 HP motor drives a small pump to create the thrust. It has a stroke of one inch and will operate valves, single seated to 4", double seated to 8".

Valve bodies are available also in piston or needle types. Actuated by ordinary two-wire thermostats, pressure stats or push button switches.

Ask for Bulletin 1082.

Degreaser Safety

Another interesting development is the self-operated Sarco type SF 11 limit control for vapor degreasers.

Should the vapor line rise above the desired level, a liquid-filled thermostat trips shut a valve in the steam or gas supply to the solvent heater. Escape of vapor over the top of the tank is thus prevented. The valve remains shut until manually reset. Available in sizes 1/2" to 2 1/2", for temperatures to 350°F and pressures to 100 psi.

Full information in Bulletin 651.



Sarco SF-11 Limit Control

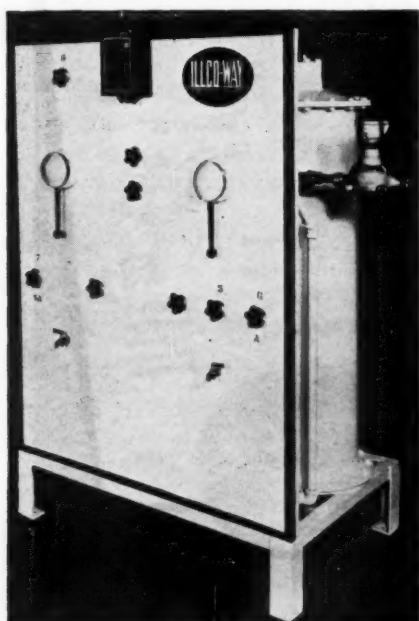
700

SARCO
SAVES STEAM

IMPROVES PRODUCT QUALITY AND OUTPUT

SARCO COMPANY, INC.

Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 3, ONTARIO



sizes of the Illco-Way Mixed-Bed De-ionizer developed by this firm. These de-ionizers will produce a water containing less than 0.1 p.p.m. total dissolved solids with silica less than 0.02 p.p.m., it is claimed. Complete information available by writing to the above address.

Polishing Tallows or Grease Sticks

Hanson-Van Winkle-Munning Co.,
Dept. MF, Matawan, N. J.

This firm announces the development of a new line of polishing tallows, available in three types; 5B41, 5B42 and 5B47.

Tallow 5B41 is a material with excellent lubricating qualities, medium high

melting point and good saponification characteristics, being very easy to clean. It is also a low-cost material.

Tallow 5B42 is of even higher grade, but is claimed to be more economical than similar tallows. It has higher lubrication and saponification properties than 5B41 and is exceptionally easy to clean, according to the firm.

Tallow 5B47 is highly saponifiable and gives good lubrication; most economical in cost.

The important economy of these materials has been achieved by use of entirely new raw materials, not by the introduction of mineral greases, waxes, oils or other unsaponifiable materials, according to the manufacturer.

Synthetic Enamel Resembles Chromium

Maas & Waldstein, Dept. MF, 438
Riverside Ave., Newark 4, N. J.

Parts which are normally chromium-plated can now be coated with a special synthetic enamel that produces a finish very closely resembling chromium in appearance, according to the above firm, manufacturers of industrial finishes.

The new finish — latest member in the M & W line of coatings — was developed as an answer to the shortage of chromium for electroplating purposes. It is applied directly over zinc or steel by spraying, and may be air-dried or baked.

Full information about Britelime is available by request on company letterhead.

Neoprene Airdry Coating

Gates Engineering Co., Dept. MF,
P.O. Box 1711, Wilmington, Del.

Neoprene, the synthetic rubber made by Du Pont, can now be applied as an airdry protective coating for industrial maintenance work on structural steel, concrete, wood and exterior surfaces of tanks and equipment.

It is applied by brush or spray gun in a single coat of 5-10 mils thickness. Outstanding properties are those which distinguish neoprene from natural and other synthetic rubber—exceptional resistance to oil, grease and chemicals; resistance to age-cracking by sunlight, weather and ozone. It also possesses the characteristic properties of any rubber product — resilience, elasticity.

high order of abrasion resistance, non-chipping and non-cracking.

An outstanding feature of the new "air-dry" coating is the fact that it develops its desirable physical properties without benefit of heat. It is a solvent solution of a specially developed neoprene composition—it will not gel or "set up" in the container, but will cure at normal temperatures after the solvent has evaporated.

Its field of usefulness will be in applications where intermittent contact with liquids or constant exposure to corrosive fumes create protective coating problems too severe for the best types of bituminous or oil-base industrial paints. Under conditions where such paints fail in two or three years, the new coating is expected to have a useful life to five or ten years, it is claimed.

Surface preparation need not include sandblasting or use of a primer, according to tests conducted by Gates, in which rusty steel was wire-brushed and wiped clean of grease and dirt, then given a single coat and tested for bond strength. After allowing a short interval for solvent evaporation and air-curing (two to seven days), bond strength was found to be entirely adequate for the coating's intended purpose.

Further information may be obtained by writing to the manufacturer at the address given above.

Plastic Protective Coating

U. S. Rubber Co., Dept. MF, Rockefeller Center, N. Y. 20, N. Y.

Development of a new air-drying plastic protective coating was announced recently by this firm.

The new coating is used to protect tanks, tank cars, pipes, fittings, structural steel parts and chemical processing equipment against attack by splash, drip and spray from corrosive chemicals, corrosive atmospheres, weathering and rust.

The plastic combines high film flexibility with good adhesion and impact resistance, it is claimed. It will not chip or crack, and can be used on steel, aluminum, concrete, hardwood, or composition board. It is applied by spray, allowing one hour drying time between coats and 24 hours drying time after the final coat. It requires no primer and can be produced in a variety of colors. Since it contains no chemical plasticizer to leech out or



NOW...simulate copper, brass and bronze on products like these with M & W PLATELUSTRE

Don't let critical metals put a *needless* crimp in your production!

Take zinc or steel—apply a coating of one of the new PLATELUSTRE finishes. You wind up with products and parts that look so much like copper, brass and bronze that *the eye can scarcely tell the difference!*

Whether you have been using now unavailable copper and its alloys for making products or for plating products,

you will find these new M & W finishes *equally* effective in keeping your plant running. There are types for air-drying and baking schedules—pick the one that best fits *your* production requirements.

Let an M & W Technical Service Engineer show you—*right in your own plant*—how easy these PLATELUSTRE coatings are to use, and what striking effects they produce. Or, if you prefer, write for free literature.

PIONEERS IN PRODUCTION

75th ANNIVERSARY
MAAS & WALDSTEIN CO.
NEWARK 4, N. J.
CHICAGO 12, ILL.
LOS ANGELES 34, CAL.
PACIFIC COAST DIVISION: SMITH-DAVIS CO., 10751 VENICE BOULEVARD, LOS ANGELES 34, CAL.
MANUFACTURERS OF INDUSTRIAL FINISHES



harden, it retains its flexibility throughout its service life, it is claimed.

A sharp instrument will cut through the film but the break can be repaired easily by "touching up" with brush or spray. Metal should be grit or sand-blasted before the coating is applied, cement should be etched with hydrochloric acid, while wood and composition board needs rough sanding to assure a good bond.

Colored Lacquers Resist Plating Operations

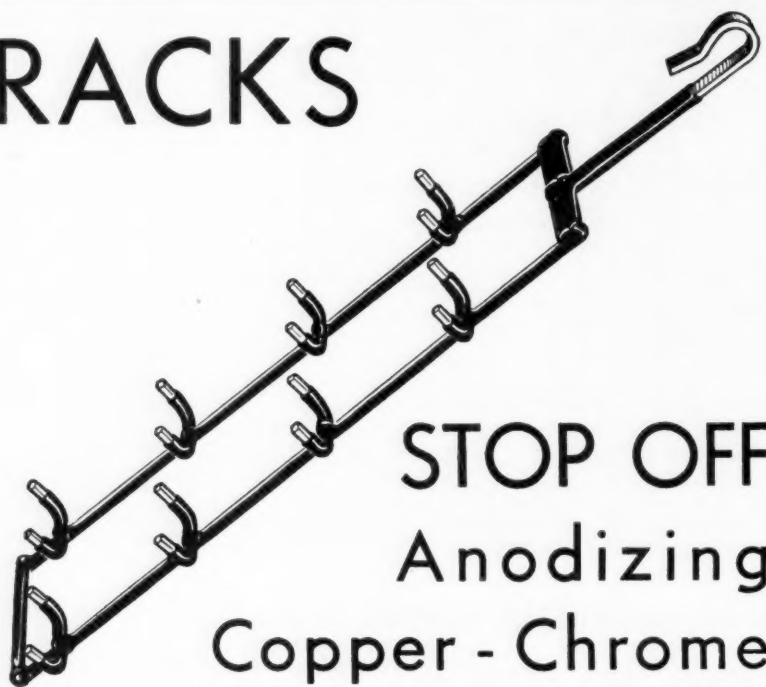
Universal Coatings, Inc., Dept. MF, 10 Avenue C, Newark 5, N. J.

The above firm has developed a line of lacquer coatings which they claim answers the need of industry

for finishes which adhere tenaciously to brass, resist the usual hot alkaline or acid washing solutions preparatory to electroplating, and emerge unaffected from plating baths.

The films are claimed to withstand, without any impairment whatsoever, hot nickel plating for twenty-two minutes followed by hot chromium plating for two and one half minutes, shearing, forming and stamping. Beautiful color designs which blend with the chromium finish are produced. Availability of this specialized quality in coatings makes possible a continuous process whereby the design is put on, employing a coating machine, and shearing carried out after electroplating, rather than resorting to the reverse procedure of shearing first, plating, and then

RACKS



STOP OFF Anodizing Copper - Chrome

The new and improved No. 1002 Paste insulation will give months of trouble-free operation on racks for zinc, tin or cadmium plating or in aluminum anodizing.

BUNATOL No. 1002 is 100% solids so there is no loss from evaporation. Tremendous chemical resistance and extremely tough to stand wear and abuse. High gloss surface stops carry over from tank to tank. Requires only a single primer coat which really holds. So simple to use — complete job in under three hours. Quick service — low labor cost — time saved. Investigate!

We also make Stop Off lacquers. No. 474 Red does a great job in hard chrome. No. 608 Green for Copper. New No. 796-CC for aluminum anodizing or chemical treatments. All quick air drying and low in cost.

A note on your letterhead will bring complete information.

NELSON J. QUINN COMPANY TOLEDO 7, OHIO
— for 15 years —
Rack Insulation Exclusively

spraying the panels individually after plating.

These tenacious, electroplating resistant finishes are being manufactured in all colors including very delicate shades and non-yellowing whites. Desired gloss is retained throughout.

Brush-Backed Polishing Head

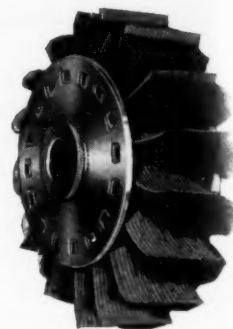
*Vonnegut Moulder Corp., Dept. MF,
1819 Madison Ave., Indianapolis 25,
Ind.*

A new portable brush-backed polishing head has been developed by the above firm, makers of the Marschke line of grinding and buffing machines and the Vonnegut 32-brush polishing head.

The portable head consists of two principal parts: an outer shell or drum,

holding sixteen replaceable brushes, and a center spool on which are coiled sixteen tips into depressions and also allow them to ride over projections of the work-piece surfaces. This ability to follow irregular surfaces instead of reshaping them, is said to make the head ideal for finishing operations on all classes of shaped surfaces.

The more common uses are polishing out die marks on formed metal parts, smoothing die castings, removing burrs and polishing surfaces of the dies and moulds which are used for making such parts, removing burrs from perforated stampings and fabricated wire products, wiping out discoloration and scratch marks resulting from grinding down weld beads and after other grinding operations, blend-



ing such areas with surrounding surfaces, polishing all kinds of ferrous and non-ferrous surfaces in preparation for buffing operations, and satin finishing flat and irregularly formed surfaces.

The central cylinder of the Head has 4 anchor pins for securing 4 abrasive assemblies — 4 strands per assembly — making up the 16 strand loading. This cylinder is rotated in relation to the outer frame to coil the abrasive strips within the head and also to release new cutting surfaces — by reversing the direction of rotation — after the abrasive ends have lost their cutting efficiency. Each of the 16 strands of abrasive is about 18" long, accounting for storage of approximately 24 lineal feet of coated abrasive.

Clear Finishes to Protect Zinc

*Maas & Waldstein, Dept. MF, 438
Riverside Ave., Newark 4, N. J.*

Manufacturers and plating shops now switching to die casting and zinc-plated steel can protect those parts with a special clear lacquer or a synthetic finish, according to the above firm.

The finishes are Dulac Clear Universal Lacquer No. 462 which is air-drying, and Codur Clear Synthetic Y743 for baking. Both have fully demonstrated their ability to stand up under salt spray and weatherometer tests for the phenomenally long period of 800 hours, according to the manufacturer.

Zinc die castings protected with these coatings are said to show no discoloration, even after long periods of service. Leading automotive manufacturers, who are currently switching to zinc to replace critical metals, report excellent results with the use of these finishes.

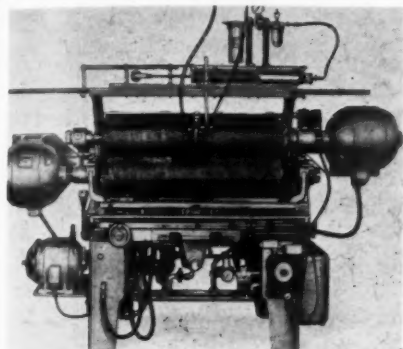
Full technical information on both the air drying and the baking types of these finishes is available on request.

Two Spindle Polishing Machine

Clair Manufacturing Co., Inc., Dept. MF, 100 S. Union St., Olean, N. Y.

Both surfaces of either flat or contoured items may be finished to any degree from flash removal to mirror finish by the Model 202 surface finishing machine recently introduced by the above firm. Designed to provide automatic float of buffs at any predetermined uniform pressure, this machine is claimed by the manufacturer to be exceptionally versatile.

This machine is equipped with two spindles to accommodate rolls 40" in width and up to 9" in diameter. The automatic hydraulic "in" and "out"



stroke is adjustable from $\frac{3}{8}$ " to 24". A bar mounted across the front serves to open instantly the rolls and arrest all actuation for loading or as an emergency measure.

A wide variety of optional features includes choice of horsepower, variable speed controls, automatic cycling devices and numerous other modifications.

For additional details on the Clair Model 202 Surface Finishing Machine write direct to the above address.

Universal Steam Trap

Velan Engineering Co., Dept. MF, 1 Exchange Place, Jersey City, N. J.

The Velan Universal Steam Trap is a new design in steam trap manufacture and differs widely from the conventional types now in use, it is claimed. This compact unit weighing 8½ lbs. is said to have the same capacity and efficiency of ordinary 2" traps weighing up to 200 lbs.

In the Velan Universal Trap seven different devices are combined together in the one small unit. These are:

1. Steam Trap; 2. Air bypass valve;
3. Check valve; 4. Self-cleaning strainer;
5. Flow control glass; 6. Temperature indicator gauge; 7. Temperature control. Complete standardization on



Start Clean... Stay Clean!

With the Strong Arm of the Law handy, no smart gal will risk all the time and money she put into getting slicked up. With Red Label Darco S-51 available, no smart plater will risk all the labor and expense of cleaning work for plating by putting the metal into a bath of questionable purity.

Start clean... stay clean! Red Label Darco S-51 adsorbs in its pores the impurities that cause trouble in plating baths... takes them out of the bath before they can be deposited on the freshly cleaned surface of your work.

Red Label Darco helps you save on scarce anode metals... helps you do a better job with thinner deposits and minimize rejects.

With clean metal...
keep the Bath Clean



Red Label Darco S-51 is especially treated for use in plating — the only carbon that meets the benzol-mercury test! It is especially easy to handle... easy to wet... easy to make into a slurry. Place your order for Red Label Darco S-51 today. Practically all suppliers carry Darco in stock, so don't accept substitutes.

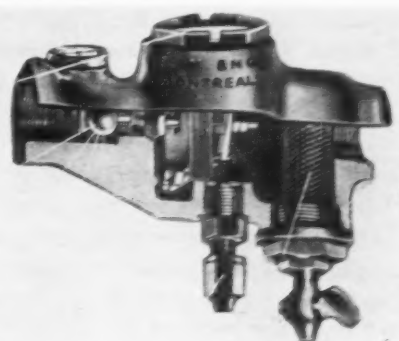
DARCO DEPARTMENT ATLAS POWDER COMPANY

Darco General Sales Offices

60 East 42nd Street, New York 17, N. Y.

one type and simplification of ordering is an advantage, as one type in one size replaces the range of ordinary steam traps from $\frac{1}{2}$ " to 2" size.

It can be installed in any position without affecting its efficiency, and in the vertical position is claimed to be absolutely frost proof, one of its most unique features.



The valve is opened by steam pressure and closed by thermal action. The bimetal element operating the valve is a function of the saturated steam curve, so that one trap can be used for a very wide range of steam pressures and temperatures. On the outlet of the trap there is a specially designed temperature gauge which accurately shows the discharge temperature at all times. This discharge temperature can be regulated through a wide range by means of an adjustment device on the outside of the trap.

Installation cost is claimed to be much cheaper than ordinary types, as there are no additional nipples, joints, elbows, check valves, air vents, etc. to be installed.

Complete catalogue and specification data may be had on request.

UNIFORM
FINISH

FASTER
PLATING

ALL SHAPES
AND SIZES

HUSSEY

Pure Copper
ANODES

Here are the basic tools for real craftsmanship in electroplating. Available in a full range of shapes and sizes, Hussey Pure Copper Anodes assure uniform finish and fast, dependable plating.

OUR 103rd YEAR

C. G. HUSSEY & COMPANY

(Division of Copper Range Co.)

ROLLING MILLS AND GENERAL OFFICES, PITTSBURGH 19, PA.

7 Convenient Warehouses to serve you promptly!

PITTSBURGH.....2850 Second Avenue
CLEVELAND.....5318 St. Clair Avenue
NEW YORK.....140 Sixth Avenue
CINCINNATI.....424 Commercial Square

CHICAGO.....3900 N. Elston Avenue
ST. LOUIS.....1620 Delmar Boulevard
PHILADELPHIA, 1632 Fairmount Avenue

Business Items

Richardson-Allen Forms Canadian Affiliate

Richardson-Allen Corp., 116-15 Fifteenth Avenue, College Point, Long Island, N. Y., manufacturers of low voltage selenium rectifiers for the plating industry and high voltage rectifiers for other industrial uses, as well as battery chargers and other electrical equipment, have incorporated a Canadian company under Dominion charter to manufacture, in so far as is possible, their complete line for that expanding market.

The Canadian company, *Richardson-Allen of Canada Limited*, is located at 370 Victoria Street, Toronto, with *Wesley S. Block, Jr.*, as president and *Cecil E. Brigham* as vice-president. Both hold the same positions with the parent company. The operations of the Canadian company will be under the direction of the secretary, *Kergan Wells*, a Canadian resident already known to the plating industry in Canada.

Nagle Elected a Director at Udylite

Election of *Lawrence V. Nagle*, vice-president and national sales manager of *The Udylite Corp.*, to the Board of Directors of the firm was announced by



L. V. Nagle

L. K. Lindahl, Udylite's president.

Mr. Nagle has been associated with The Udylite Corp. since 1927 when he started as a salesman in the Detroit area for this manufacturer of electroplating equipment. He was appointed Michigan Sales Manager in 1938 and named chief of national sales in 1944.

Niagara Alkali Elects Two Vice-Presidents

William J. Weed, Manager of Sales, and *Louis E. Bauer*, Manager of Production for *Niagara Alkali Co.* have been elected vice-presidents of the company.

Mr. Weed has been with the company since 1913 and Mr. Bauer since 1917.

Mr. Weed has served as a director of the company since 1941. He is a past trustee of the Chemists Club of New York, and a member of the New York Board of Trade, Synthetic Or-



W. J. Weed



L. E. Bauer

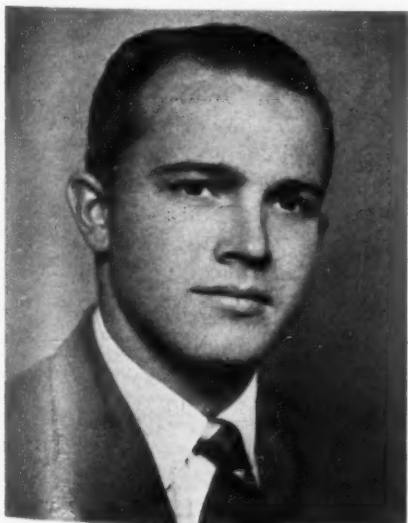
ganic Chemical Manufacturers Ass'n., Sales Executives Club of New York, and other organizations.

Mr. Bauer, who graduated from Brown University in 1916, is a member of the Niagara Falls section of the American Chemical Society, and of the Chemists' Club of New York. With his election as vice president of Niagara Alkali, Mr. Bauer also has been made a director of the company.

Solla New H-VW-M Salesman at Boston

The Hanson-Van Winkle-Munning Co., of Matawan, N. J., announces the appointment of *Calvin E. A. Solla* to their sales force.

Mr. Solla is a native of Bristol, Pa. He served two years with the U. S. Army and later attended Lafayette College, Easton, Pa., graduating in 1950 with a degree of Bachelor of Science. After several months in the



C. E. A. Solla



CHROMIC ACID

OTHER NAMES: Chromic Anhydride, Chromium Trioxide

FORMULA: CrO_3

MOLECULAR WEIGHT: 100.01

DESCRIPTION: Deliquescent, dark red flakes. Bulk density averages 105 lb. per cu. ft.

CrO_3	99.75% min.
Chloride as Cl	0.01% max.
Sulfate as SO_4	0.1% max.
Insoluble in water	0.01% max.

USES: Chromium plating. Anodizing of aluminum. Metal surface treatment, including cleaning, pickling, etching, coloring and improvement of corrosion resistance and paint adherence. Pigment manufacturing. Organic oxidation syntheses, as in the production of dyestuffs and pharmaceuticals. Manufacturing other chromium chemicals and catalysts.

SHIPPING CONTAINERS: Steel Drums — 100 lb. net.

OTHER MUTUAL PRODUCTS

Sodium Bichromate
Potassium Bichromate

Sodium Chromate
Potassium Chromate
Ammonium Bichromate

MUTUAL CHEMICAL COMPANY OF AMERICA

270 Madison Avenue New York 16, N. Y.



training course with H-VW-M, in the laboratory and in the works, he has gone into the field with headquarters at 258 Park Square Building, Boston, Mass.

Curran Corp. Licenses Firm to Market Cleaning Compounds

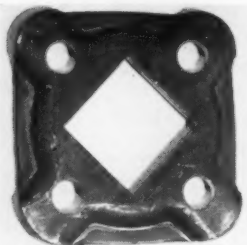
The formation of a new company, *Gunk Atlantic, Inc.*, South Canal St., Lawrence, Mass., a new company licensed by *The Curran Corp.*, to manufacture and market Gunk solvents throughout the entire eastern United States from Maine to Louisiana, has recently been announced.

Wider use of Gunk self-emulsifying solvents necessitates a division of

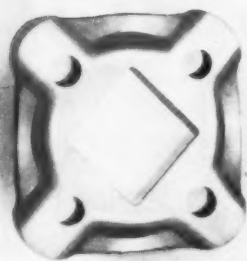
work. *Mr. A. F. Curran*, Chemical Engineer and original inventor of Gunk Self-Emulsifying and Self-Scouring Solvents will be able to concentrate his energies on chemical laboratory development with the view of continuously improving present products as well as creating new ones. Mr. Curran will also be associated with the new company to solve various technical problems which may come up in the field.

Gunk Atlantic, Inc., will concentrate on plant operation and production and will carry out an aggressive selling and merchandising program.

There is no intention of changing basic policies or the sales outlets now in existence.



Heat Scale and Rust Removal Without the Use of Dangerous Liquid Acids



Magnus offers a new crystalline acid material—D-Scale-R-S for pickling and derusting of metals. It is a scientifically compounded product of dry, inert chemicals that eliminates many of the hazards associated with liquid pickling acids.

Advantages offered by Magnus D-Scale-R-S

- Safe to use—non-inflammable and non-explosive.
- Eliminates danger of overpickling.
- No dangerous handling or storage problem.
- Economical to use.
- Use hot or cold.
- Eliminates acid fog.
- More convenient than liquid acids.

Magnus D-Scale-R-S can be used to advantage whenever sulphuric or muriatic acid is used for removal of scale or rust from metal.

Write for Bulletin No. 36.

MAGNUS CHEMICAL CO. • 11 South Ave., Garwood, N. J.
In Canada — Magnus Chemicals, Ltd., Montreal.
Service representatives in principal cities



MAGNUS

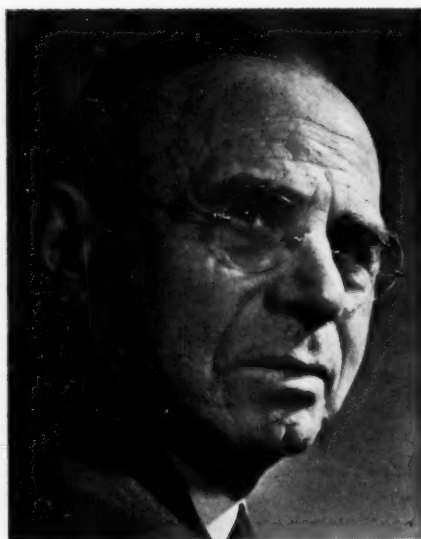
CLEANERS • EQUIPMENT • METHODS

Dr. John F. Thompson Elected Chairman of the Board of International Nickel

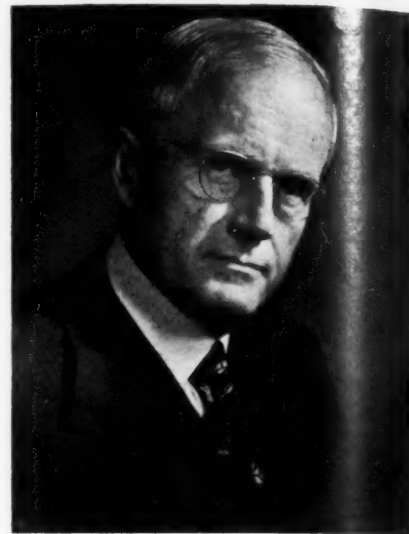
Dr. John F. Thompson, President of The International Nickel Company of Canada, Limited, was elected to the additional office of Chairman of the Board of Directors, succeeding the late Robert C. Stanley.

Dr. Paul D. Merica, Executive Vice-President and a Director, was elected a member of both the Executive Committee and the Advisory Committee of the Company.

Dr. Thompson joined the Company in 1906 as metallurgist. He was in charge of all research and technical activities on Monel and malleable nickel, and head of all field and out-



Dr. J. F. Thompson



Dr. P. D. Merica

side plant operations from 1906 to 1918. He became Manager of Operations in 1921, was elected Assistant to the President in 1928, and was made a Director and a member of the Executive Committee in 1931, a Vice-President in 1932, Executive Vice-President in 1936, and a member of the Advisory Committee in 1937. Dr. Thompson succeeded Mr. Stanley as President in February, 1949.

Dr. Merica has been Executive Vice-President since 1949. He first became associated with the Company in 1919, becoming Director of Research and subsequently Associate Manager of the Development and Research Department. Dr. Merica was elected Assistant to the President in 1931, a Director in 1934 and a Vice-President in 1936.

Atlas Mineral Appoints St. Louis Representatives

Shutt Process Equipment Co., operated by George T. Shutt, has just been appointed agents for Atlas Mineral Products Co. for chemical resistant materials of construction in the St. Louis Territory. Mr. Shutt is a graduate of Washington University with a degree in chemical engineering. He is a veteran of World War II and has been associated with the Aluminum Ore Company, St. Louis, Mo., in the purchasing department for a number of years.

Production Machine Co. Appoints Ohio Representative

R. W. Schwartz, sales and service engineer, has been transferred from the home office in Greenfield, Mass. Mr. Schwartz has been active in the company's experimental and sample



R. W. Schwartz

finishing laboratory for the past several years, and has acquired a variety of factual information in the polishing field.

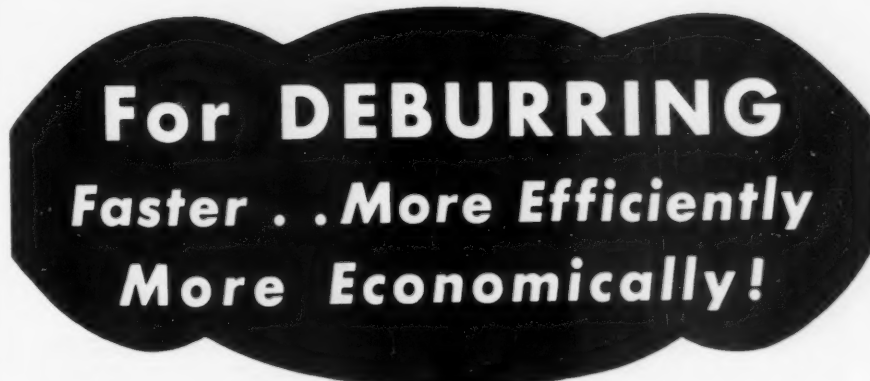
The *Production Machine Co.* manufactures several types of centerless polishing and finishing machines, and because of the highly specialized nature of this equipment, well trained personnel is required for presenting it intelligently to the prospective user. Mr. Schwartz will also service the many customers now in his territory and expects to work very closely with dealers now handling the Production line as well as the manufacturers of abrasive products which are used on the machines.

His territory will include the State of Ohio, western New York and Pennsylvania, and northern sections of Kentucky and West Virginia. He will be located in central Ohio, convenient to all points.

G. Millard Whitney Now Wyandotte Syracuse Manager

G. Millard Whitney was recently appointed manager of Wyandotte Chemicals' Syracuse district by Robert L. Reeves, general manager of the J. B. Ford Division. Mr. Whitney joined Wyandotte Chemicals in 1940 as a Baltimore representative. His service with Wyandotte was interrupted by three years with the U. S. European Army — joining as a private and rising to a Captain.

George J. Lawrence has been Wyandotte Chemicals' Syracuse manager since 1933, and is retiring under the Company's pension plan. Mr. Lawrence joined Wyandotte Chemicals in 1912.



Be Sure to Investigate...
the **SPEEDIE** Way!



THE KEYNOTE of today's defense program is *efficiency*! For an efficient deburring operation—whether on aluminum, brass or steel—you must have the *right compound* to remove burrs and heat scale as quickly and economically as possible!

SPEEDIE Deburring Compounds were developed for the defense effort. Tried and proven, they'll handle the toughest job faster . . . at lowest cost . . . and they'll save your wheels!

Tell us your deburring problems. We'll suggest the right SPEEDIE Deburring Compound that will do the job best! Write today.



Polishing Room Supplies and Equipment

THE BUCKEYE PRODUCTS CO.

7033 Vine Street Cincinnati 16, Ohio

Cable address: Buckprod



G. M. Whitney

Mutual Operating New Chromium Chemical Plant

Mutual Chemical Company of America has announced the completion of a new chromium chemical plant to increase the production of sodium bichromate and other essential chromium compounds. The new plant is located on the Baltimore harbor, adjoining facilities constructed previously, and is said to be the largest and most modern chromium chemical plant in the world. As shown in the accompanying airview of Mutual's Baltimore property, the largest of the new structures on the right is the sodium bichromate plant. In the new building in the left foreground, other chromium chemicals are

SAVE

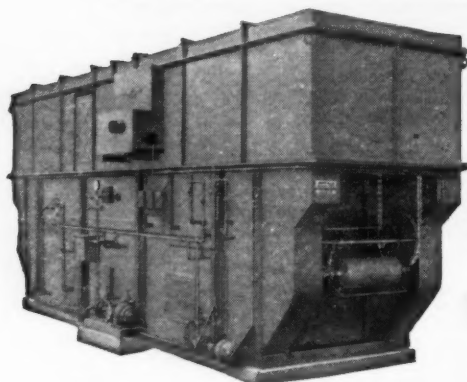
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OPTIMUS

VAPOR DEGREASERS



You can save dollars on your cleaning operations by installing an OPTIMUS Vapor Degreaser in your production line. With its use metal parts cleaning is speeded up and made more efficient. Grease, oil and dirt are quickly and effectively removed from the parts by the vapors of the solvent. Chips, insoluble impurities, buffing compounds and stubborn dirt are completely removed with clean solvent flushing. Maintenance and operation costs are at a minimum. Solvent is distilled and reclaimed automatically.



TRICHCLORETHYLENE and
PERCHLORETHYLENE
— for all Vapor Degreasers
Warehouse stocks in all principal
cities and industrial areas.

OPTIMUS VAPOR DEGREASERS available in all types, vapor, vapor-immersion, vapor-spray and combinations. All sizes from small batch-type degreasers to custom-built monorail or cross-rod conveyor models.

WRITE FOR—complete catalog, or submit your metal cleaning problem, without obligation, for our study and recommendation.

Optimus Equipment Company

MATAWAN, NEW JERSEY • OFFICES IN PRINCIPAL CITIES



MANUFACTURERS OF
VAPOR DEGREASERS, WASHING, RINSING,
PICKLING & DRYING EQUIPMENT FOR METAL PARTS



Airview of Mutual's new Baltimore Plant for producing chromic acid and other chromium chemicals.

manufactured from sodium bichromate.

With these additional facilities at Baltimore, Mutual's productive capac-

ity is substantially increased. Operations have already commenced in the new plant and are expected to reach progressively higher levels over the

next few months. The demand for chromium chemicals has been exceptionally heavy, and, partly as a result of extended soda ash strikes in 1950, output of the industry has not been able to meet all demands. New capacity coming into production now is therefore particularly timely and will be most helpful in assuring adequate supplies of chromium chemicals.

R. W. Brisky New Grand Rapids Representative for the Electric Products Co.



R. W. Brisky

The Electric Products Co. announces that R. W. Brisky is their new representative in Grand Rapids, Mich. As a member of the Arthur B. Sonneborn Co., Mr. Brisky is well qualified to handle the sale and application of the E. P. line of battery chargers, electrolytic motor-generators and large motors and generators. Since his graduation from Case Institute of Technology as an electrical engineer, he has spent several years in industrial sales and engineering work as well as 39 months in the United States Navy.

3M Co. Appoints New England Distributors for Barrel Finishing Materials

Recently appointed as the New England distributors for Minnesota Mining's line of barrel finishing chips and compounds is the Industrial Supplies & Equipment Co., King Street, Greenwich, Conn. This firm specializes in barrel finishing engineering, and also handles Murco tumbling barrels, Link small-lot tumblers, and Norton Alundum tumbling abrasives.

Mr. Richard Choura, of Hartford, Conn., is representing ISE in the Northern Conn. and Western Mass.

areas. He has had 18 years experience in the barrel finishing field, being formerly employed with the Underwood Typewriter Co. and Colt's Patent Firearms Co. He is available to manufacturers in the above region for help with their barrel finishing procedures.

Vereeke New Sales Manager for Heil Process Co.

Appointment of *Edwin Vereeke* to the position of Sales Manager, with charge over all sales and advertising.



Edwin Vereeke

is announced by the *Heil Process Equipment Corp.*, Cleveland, manufacturers of chemical-resistant tanks and linings, tank heaters, anodes, and related products. Mr. Vereeke has been with the Heil Corp. in the capacity of District Sales Supervisor.

Also announced are the appointments of *Robert Peters* as Sales Engineer for the area west of Cleveland, and *Ken Grader* as Sales Engineer in charge of the area east of Cleveland. Mr. Peters was previously an Estimating Engineer for Heil. Mr. Grader, formerly of Philadelphia, will make his headquarters in Cleveland.

These appointments are in line with a policy of expanding service for the well-known Heil line of equipment.

Wyandotte Representatives Attend Product Application Conference

Ten representatives of *Wyandotte Chemicals Co.*, industrial detergents department, recently attended the first of a series of 1951 product application schools at the Company's laboratories in Wyandotte, Mich. During the week, demonstrations and discussions cov-

HOLD IT!

Are you troubled with finishing problems on defense orders?

**HOLD IT...
PHONE SIEFEN!**

NUGLU and BRUSHING NUGLU are exceeding today's specifications as they have in past crises.



J. J. *Siefen* CO.

**5643 LAUDERDALE • DETROIT 9, MICH.
Nationwide polishing and buffing service**

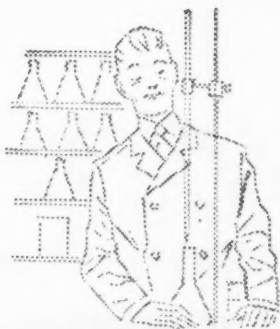


Shown inspecting the model of Wyandotte's new Research Center, now under construction are left to right, seated: R. C. Fancher, Detroit; S. M. Grandy, Atlanta; R. W. Shallcross, Louisville; J. W. Baker, Cleveland; J. J. Glass, Pittsburgh and A. J. Frieling, Dayton. Standing: R. J. Racine, Technical Service Department; J. L. Grimme, Kansas City; C. C. Craven, Grand Rapids; H. V. Gervais, Detroit; C. J. Martin, New York; Andrew Liger, Research Supervisor, Wyandotte Industrial Laboratories and Dr. R. E. Heath, Manager Market Development, Industrial Detergents. The new industrial laboratories are to be located in the wing toward which Dr. Heath is pointing.

From the developers of

IRIDITE®

ARP BRIGHTENERS for ZINC and CADMIUM PLATING



Bright plating troubles go down the drain when you specify ARP Brighteners for zinc or cadmium solutions in barrel, still or automatic equipment! Three trouble-free, efficient formulae, developed in Allied Research laboratories, are available to help you consistently produce a fine grained, clear and sparkling-bright plate:

1. For lowest cost operation of zinc plating without subsequent bright dipping or passivation! Increases solution efficiency to as high as 98% in low current densities. Produces a clear bright plate with a blue chrome-type cast.
2. For zinc plating followed by bright dipping or chrome passivation with Iridite! Lowest cost at high current densities. Yields a plate with a yellow nickel-type cast.
3. For cadmium plating. Produces a silvery bright deposit at any current density.

All three ARP Brighteners offer you many operating advantages including: better throwing power, increased solution efficiency, more efficient metal consumption, uniform coverage, reduced rejects, lower operating costs, higher quality work, ease of use.

INVESTIGATE TODAY! Ask your Iridite representative for full information or write direct. Mention type of plate desired and equipment used in your shop.

Manufacturers of Iridite finishes for corrosion resistance and paint systems on non-ferrous metals; ARP plating chemicals

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD

ered cleaning material application in all types of metal working and finishing operations as well as cleaning and maintenance operations in the railroad and aircraft industries.

Discussions were lead by members of Wyandotte Chemicals Research and Technical Service Departments. Numerous results of field tests of new products and case histories of actual plant operations were studied by the Wyandotte supervisors.

International Rectifier Corp. Adds Second Story

In order to meet increased production requirements, the *International Rectifier Corp.* has added a second story to its plant located at 6809 S. Victoria Avenue, Los Angeles 43, Cal.

This firm manufactures its products in a modern completely air-conditioned plant with increased facilities for the



development and manufacture of selenium rectifiers and photocells.

Udylite Presents Sales Awards at Annual Meeting

Twenty-one awards, 14 for outstanding sales records and seven for 15 or more years of continuous service were presented to employees of *The Udylite Corp.* at the firm's annual sales meeting.

L. K. Lindahl, president, and L. V. Nagle, vice-president and national sales manager of the plating supply and equipment company, made the presentation following a banquet at the Fort Shelby Hotel. A special award, a gold pin for 25 years of service was presented to Mr. Lindahl by C. H. Reeme, Udylite's treasurer. W. J. Cluff, president of *Frederic B. Stevens, Inc.*, a subsidiary of *The Udylite Corp.*, was presented a gold watch by Mr. Lindahl in token of fifty years of service with the Stevens organization.

Seven salesmen who topped the million dollar mark in sales for 1950 were given awards signifying membership in the Udylite "Million Dollar Club". They were: *Larry Stockwell*, Detroit; *David Stockton*, Chicago; *Jim Fitzgerald*, Detroit; *Vincent Kelly*, Indianapolis; *Joe Hoefer*, Detroit; *Lou Minbiolo*, Detroit; and *William Moyer*, Philadelphia. Seven other Udylite salesmen were honored for total sales of more than one-half million dollars last year. They were: *William Young*, Cincinnati; *Harvey Zens*, Detroit; *Jim Clifford*, New York; *Ed Stack*, Chicago; *Wilfred Moffatt*, Cleveland; *G. Woodruff*, Cleveland; and *A. Schuenemann*, Cleveland.

Employees who were honored with awards for 15 years of service were: *H. J. Ward*, Detroit district sales man-

agers: William Jackson, Detroit; Dr. R. B. Saltonstall, Detroit; John Pear-sall, Cleveland; Lloyd Withington, De-troit; Herman Marasus, Detroit; Vin-cent Zobel, Detroit.

The sales meeting was launched Feb. 26, and continued for three weeks. Udylite salesmen from all over the na-tion were briefed by various depart-ment heads on the aspects of the metal finishing field in the light of the pres-ent defense program. Mr. Nagle con-ducted the course.

Cro-Plate Opens New Plant



The Cro-Plate Co., Inc., of Hartford, Conn., manufacturers of the Cro-Hone wet blast equipment and the Cro-Plater complete hard chrome plating units, announce the opening of a new plant in Hartford 5, Conn. The new facilities include one of the largest and most complete hard chrome plating plants in New England, as well as facilities for manufacturing their plater and wet-blast equipment.

Keystone Increases Floor Space

Keystone Carbon Company, Saint Marys, Pa., has recently completed the addition of 20,000 sq. ft. of floor space for the manufacture of powder metal parts and negative temperature coefficient resistors, as well as for office, storage, and engineering facilities. The expansion was begun about six months ago and represents a 22% increase in floor space, making a total of 91,000 sq. ft.

Keystone Carbon Company was or-ganized in 1927 and has grown steadily since its founding. Floor space has ap-proximately doubled since the end of World War II. In addition to powder metal parts and negative temperature coefficient resistance material, the com-pany makes a complete line of metal graphite collector ring and commutator brushes and metal graphite and carbon contacts.

Wyandotte Chemicals' Ford Division Managers Map Conversion Program

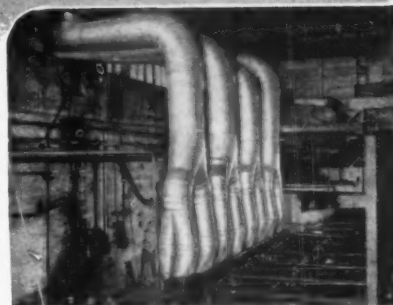
Assistance to metal finishing and

Ohio FUME AND DUST REMOVAL SYSTEMS TANGIBLE DOLLAR SAVERS

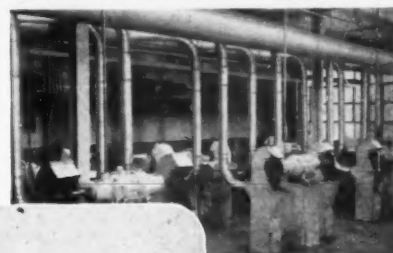
Records on hundreds of Ohio Blow Pipe jobs prove without question that produc-tion output materially increased and em-ployee absence and complaints radically decreased after the installation of an Ohio System for ventilation of fumes from plating and rinse tanks and dust collection from grinding, polishing and buffing.

Ohio Systems are not standard fit-all sys-tems. They are designed and engineered to meet your individual requirements. Ohio engineers, thoroughly experienced in their field, make a careful, exacting survey of your plant and an analysis of conditions and then plan the system that will meet most efficiently your special needs and conditions.

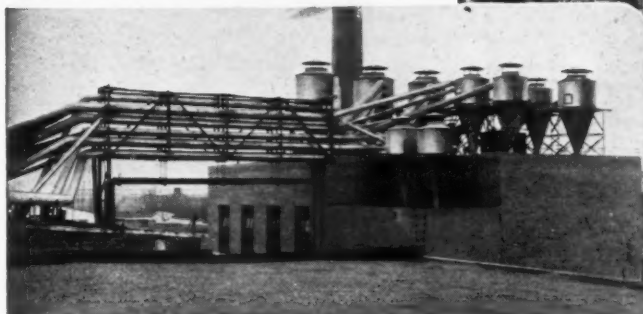
Call, write or phone today and let Ohio engineers make a survey and give you, without obligation, an estimate.



Fumes Removal Installation in Plating Room



Dust Collecting System for Buffing Machines



Cyclone Type Dust Collectors

Write today for free illustrated color folder showing you how an "Ohio" system protects your profits.

Ohio BLOW PIPE CO.
ENGINEERS AND MANUFACTURERS
1725 DOAN AVENUE • CLEVELAND 12, OHIO



metal processing manufacturers con-verting to defense production was one of the key topics discussed by Wyandotte Chemicals, J. B. Ford Div. dis-trict sales managers at a recent week's conference. Particular emphasis was placed on products which meet process requirements of JAN-C-490 Grade I, Type 2; Grade II, Type 6.

Wyandotte's president, Robert B. Semple, was featured speaker at the closing dinner. The Ford Division man-agers inspected the construction pro-gress of the new Wyandotte Chemicals Research Center which will permit the company to increase its already sub-stantial contribution to the defense program.

Here's the *Practical Finish* to **REPLACE PLATING**

Strathmore Protective Chrome and Metal Coating . . . so essential to the long-life of any "plating replacement" method of metal finishing. Water-white, high solids, will not discolor. Extreme resistance to impact and abrasion. 200 hours of salt spray show no visible break-down of film—exceeds standard chromium specifications. Can be dipped or sprayed.

Baking Type

BAQUIK Clear Coating X2534. Baking range, from 225°F. for 1 hour to 300°F. for 15 minutes. Approved by leading auto manufacturers.

Air-Drying Type

METALBOND Clear Coating SL-300 dries quickly without baking.



Provides Long-Life Protection for the SCANT CHROME FINISH

Temporarily Allowed

Write, Wire or Phone for Samples and Prices

Strathmore Products, Inc.

1970 W. FAYETTE ST. Phone 4-2118 SYRACUSE 4, N.Y.

Corrosion Course to be Given at M.I.T.

Leading industrial authorities will join members of the M.I.T. faculty to present a one-week intensive course in Corrosion at the *Massachusetts Institute of Technology* from June 18 to 23, 1951, according to Professor *Walter H. Gale*, Director of the M.I.T. Summer Session.

Principal purpose of the week-long event will be to bring new information about corrosion control within the reach of men in industry. The course will be under the direction of Professor *H. H. Uhlig*, in charge of the Institute's Corrosion Laboratory.

The course will cover the characteristics and mechanisms of corrosion and corrosion control. On the schedule

are discussions of the design of equipment, chemical treatment of the environment, cathodic protection, and selection of coatings and alloys economically feasible for reducing corrosion losses.

The following lectures are scheduled:

"*Fundamentals of Corrosion Reactions and Control*,"—*H. H. Uhlig*, Associate Professor of Metallurgy, M.I.T., and *Carl Wagner*, visiting Professor of Metallurgy.

"*Metals and Alloys: Properties, and a Guide to their Proper Selection*,"—*W. Z. Friend*, International Nickel Co., Inc.

"*Cathodic Protection*"

Theory and Measurements, *J. M. Pearson*, Sun Oil Co.

Practice and Economics, *L. P. Sudrablin*, Electro Rust-Proofing Corp.

"*Metallic and Organic Coatings: Selection, Application, and Behavior*,"—*R. M. Burns*, Bell Telephone Laboratories.

"*Treatment of Environment*,"—*Norman Hackerman*, Department of Chemistry, University of Texas.

"*Design of Equipment from a Corrosion Standpoint*,"—*R. B. Mears*, Carnegie-Illinois Steel Corp.

"*Principles and Practices of Corrosion Testing*,"—*F. L. Laque*, International Nickel Co., Inc.

Lectures will be accompanied by demonstrations, and there will be ample opportunity for questions and informal discussion. Those attending may reserve rooms in the Everett Moore Baker House, M.I.T.'s ultra-modern dormitory overlooking the Charles River Basin and the Boston skyline.

Further information may be obtained from Professor *Gale*, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

Manufacturers' Literature

Industrial Filters

The Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Chicago 50, Ill.

This firm has issued a new eight-page catalog which gives details on the construction and operation of Industrial's pressure filters for solution clarification. It gives complete information on the various standard models, types, and sizes for electroplating, electroforming, nickel dip and neutralizer solutions.

A copy of this catalog may be had by writing to the above address.

Abrasive Tumbling Media and Compounds

Almco Div., Queen Stove Works, Inc., Dept. MF, Albert Lea, Minn.

A new bulletin issued by this firm gives details and operating instructions for their extensive line of barrel tumbling and burnishing compounds and abrasives. Bonded abrasive chips, regular abrasive chips, Oxide chips, and several grades of compounds are covered and characteristics given. Copies of this informative bulletin may

be obtained by writing to the above address.

Polishing and Buffing Accessories

The Manderscheid Co., Dept. MF, 810 Fulton St., Chicago 7, Ill.

This firm has issued a new bulletin describing their line of backstand idlers, work-holding spinners, balance ways, emery troughs, tube polishing attachments, wheel rakes, work support rollers, tapered screw points, balance weights for polishing wheels, chucks, wheel bushings, and many other essential polishing room needs. Copies of the bulletin are available by writing to the above address.

Industrial Brushes

The Osborn Manufacturing Co., Dept. MF, 5401 Hamilton Ave., Cleveland 14, O.

A new three-color brush catalog, designed to simplify selection of the best brush for the individual job, has just been issued by this firm.

The new catalog contains 76 pages and presents numerous illustrations of industrial brushing operations, in addition to photographs and description of Osborn's complete line of power, paint, varnish and maintenance brushes.

The publication includes a three-page digest of the origin of Osborn brush materials from many parts of the world, a three-page section devoted to factors involved in selecting the right brush for specific jobs, and including operating equipment requirements, brush characteristics, operating conditions, surface speeds and other helpful information regarding brush usage.

Many of the photographs show brushes in actual use, thus giving readers the advantage of seeing various types of brushing setups.

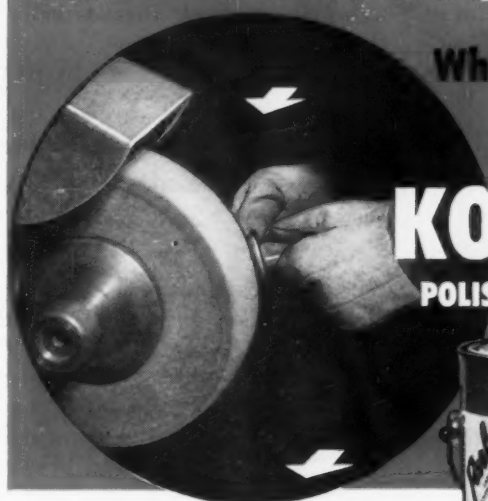
Full information on Osborn's complete line of wire and fibre wheel brushes, paint and varnish brushes and maintenance brushes is included.

Removing Silica by Deionization

Resinous Products Div. Rohm & Haas Co., Dept. MF, Washington Square, Philadelphia 5, Pa.

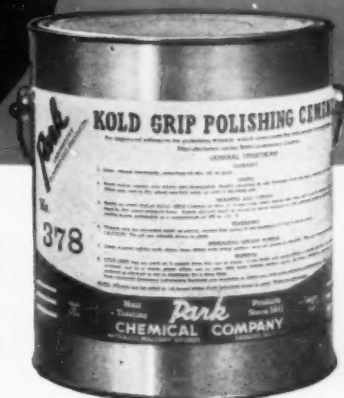
A new four-page folder emphasizing silica removal by Amberlite deionization has been prepared by this firm.

Wheels CUT FASTER, LAST LONGER



When treated with

Park
KOLD-GRIP
POLISHING WHEEL CEMENT



KOLD-GRIP Polishing Wheel Cement, laboratory-controlled through every step of production, will arrive at your plant *ready for use!* Viscosity is constant, regardless of normal temperature variations and the cement can be applied directly from the container . . . *without mixing or heating.* Kold-Grip is clean, odorless and very easy to handle.

Coarse or fine-grain abrasives set up right for fast cutting efficiency. Substantial savings are effected through longer over-all wheel life, fewer setups and reduced wheel inventory.

Wheels dry rapidly, are unaffected by humidity changes, and may be stored in any convenient plant area.

Let our polishing engineer demonstrate Kold-Grip for you, or send for free sample, telling us the metal to be polished, grain sizes to be used, and drying facilities available. We can help you if we hear from you.



• Liquid and Solid Carbonizers • Cyanide, Neutral, and High Speed Steel Salts • Cokes • Lead Pot Carbon • Charcoal • No Carb • Carbon Presenter • Quenching and Tempering Oils • Drawing Salts • Metal Cleaners • Kold-Grip Polishing Wheel Cement
LICENSED MANUFACTURER: Electro-Resistance Furnace Co., Ltd., Wetherby, Surrey, England

The two-color folder is designed to help the chemical engineer generally to evaluate the usefulness, applications and recommended layout of ion exchange systems to provide water practically totally free from hardness, carbon dioxide and silica.

Text explains what results may be expected from Amberlite Monobed (single bed) as well as multiple-bed systems; describes how deionization works; and suggests typical uses in the process and power industries. A full page, illustrated with block diagrams, presents case histories with results attained in deionization by typical Amberlite Monobed, two-, three- and four-bed systems. The folder, titled "Zero Hardness by Amberlite Deionization," is available on request.

Metallizing Process

Metallizing Company of America, Dept. MF, 3520 W. Carroll Ave., Chicago 24, Ill.

A new 20-page bulletin on the Mogul metallizing gun, subtitled "Production-Maintenance Miracles Now with The Metallizing Gun of Tomorrow," has just been published by the above firm. The bulletin is fully illustrated and tells how this process aids in fighting corrosion, rebuilding worn parts, and reclaiming mis-machined castings.

Advanced Barrel Finishing

Almco Supersheen, Dept. MF, Albert Lea, Minn.

A treatise on advanced barrel finish-

ing has just been published by this firm. This new 20-page booklet illustrates and describes the full range of application of this new finishing technique. Many "before and after" pictures are shown, together with modern equipment and full information about abrasive chips and compounds employed in advanced barrel finishing.

This worthwhile endeavor on the part of Almco has been highly praised by engineers and processors, and is a must reading for any manufacturer who barrel finishes metal parts.

A free copy of this booklet may be obtained by writing to the above address.

Chromelike Bright Finish

Allied Research Products, Dept. MF, 4004-06 E. Monument St., Baltimore 5, Md.

A detailed technical bulletin on the use of zinc plate and Iridite chromate chemicals to replace conventional chrome plating in producing bright decorative finishes has been released by the above firm.

In describing the use of the Iridite

chemicals in such finishing systems the bulletin sets forth comparisons of the appearance, corrosion resistant and abrasion resistant characteristics of the finished surface.

Copies may be obtained by writing the manufacturer.

Special Blast Cleaning Problems

American Wheelabrator & Equipment Corp., Dept. MF, 555 S. Byrkit St., Mishawaka, Ind.

The application of specially designed airless blast equipment to 39 production cleaning problems, such as those encountered with automotive and railroad equipment, tubing and soil pipe, steel drums, sanitary ware, and asphalt tile, is fully described and illustrated in a new 23-page brochure just published by the above firm.

The problems are taken from practically every major industry in the metals and metal-working field. Anyone confronted with cleaning and finishing problems, wherein the nature of the product or the production rate dictates the use of blasting equipment which employs special work-handling

mechanism, will find this booklet highly informative.

Heavily illustrated with drawings and installation photographs, the catalog gives some production figures in specific cases. For a free copy of this booklet, write to the above address.

Metal Cleaning Compounds

MacDermid, Inc., Dept. MF, 526 Huntingdon Ave., Waterbury 20, Conn.

This firm has recently issued technical data sheets describing their various metal cleaning materials for preparation of parts for electroplating. Also included is information on their line of specialty products, such as acid inhibitors, zinc strippers, blackening salts, nickel stripper, bright copper plating bath, wetting agents for chrome baths, nickel activator, and many other special purpose materials vital to successful plating room operations. Properties and recommended uses for each material are given.

Copies may be obtained by writing to the above address.

ANOTHER DAVIS-K DEVELOPMENT

(ORIGINATORS OF "ONE OPERATION" ANTIQUE GOLD SOLUTIONS)

A "One Operation" WHITE GOLD" Antique Plating Solution Simple To Operate - Constant Uniform Deposits - Economical.

DAVIS-K—makers of GOLD PLATING SOLUTIONS—prepared in all colors that produce hard, tarnish-resistant, color constant deposits.

Compounded from U. S. Treasury GOLD and highest (C.P.) chemicals. Sold by troy weight — certified 100% gold content.

Solutions are simple to operate and maintain.

ANTIQUÉ SOLUTIONS—Deposit gold and antique in one operation — produce uniform finish — simple to operate. Your samples plated at no charge.

We welcome inquiries pertaining to precious metal plating problems. Distributors of Bakers' lustrous RHODIUM SOLUTIONS, that produce a long-lasting white finish.

"Where Glittering Elegance Reflects Lasting Quality."



DAVIS-K PRODUCTS CO.

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New York 10, N. Y.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY



Buffalo Convention

The entire program of technical papers at this year's A.E.S. Convention in Buffalo will center around the preparedness program. Topics of immediate interest to platers and finishers in meeting the country's needs during the shortage of vital materials will be discussed by experts in each field.

The keynote speaker at the opening session on Monday morning will be Dr. William Blum, of the National Bureau of Standards. The afternoon session will feature a symposium on the engineering aspects of plating room operation.

Tuesday's session will be devoted to finishing and plating of die-castings, and substitute finishes for civilian items. Wednesday morning meetings will have as their topic the control of plating baths, and Thursday morning will feature a report on the progress of A.E.S. Research. No sessions are scheduled for the afternoons of Wednesday or Thursday, as the picnic and Annual Meeting will occupy that part of the schedule.

The host branch is busy arranging a full social schedule to help those attending get the most out of their week in Buffalo. The International Fellowship Club will sponsor their annual get-together buffet and entertainment on Monday night, as well as the annual golf tournament on Wednesday. A grand picnic is planned for Wednesday afternoon, and the final night will feature the Annual Banquet and entertainment.

The Fellowship Club will hold its only general meeting of the year at a special luncheon on Monday.

The ladies will enjoy a trip to nearby Niagara Falls, several special luncheons and a Ladies Party on Thursday, as well as the regular picnic and Annual Banquet and Fellowship affairs.

Reservations

Persons planning to attend the Convention during the week of July 30th are urged to make their hotel reserva-

THE

Balanced SOLVENT...

FOR ALL JOBS

BLACOSOLV

FOR ALL METALS OR COMBINATION OF METALS

Blakeslee SOLVENT VAPOR DEGREASERS
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tions early to be sure of getting the accommodations they want.

The headquarters hotel is the Statler, where the technical sessions and various social affairs will be held. There are a number of other excellent hotels nearby for those who might want them.

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Hotel	Single	Double	Twin	Suites
Buffalo — Washington & Swan Sts.	\$3.50 - \$5.00	\$6.00 - \$8.00	\$7.00 - \$8.00	
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Lafayette — Washington & Clinton	3.75 - 5.00	6.50 - 10.00	7.00 - 10.00	
Lenox — North Near Delaware	4.50 - 5.00	7.00 - 7.50	7.50 - 8.50	
*Markeen — Route 5 - Main at Utica ..	2.75 - 4.50	5.75 - 8.50	5.75 - 15.00	\$16.00
Midtown — 430 Delaware Ave.	3.00 - 5.00	5.00 - 10.00	7.50 - 10.00	
*Richford — 210 Delaware Ave.	2.25 - 3.75	4.00 - 7.00	4.00 - 7.00	
Sheraton — 715 Delaware Ave.	4.50 - 10.00	4.85 - 6.75	7.65 - 14.00	
Statler — Delaware Ave. at Niagara Sq.	4.50 - 7.50	8.00 - 10.00	9.00 - 14.00	14.00-24.00
Stuyvesant — 245 Elmwood Ave.	5.00 - 8.00	7.50 - 10.00	8.00 - 14.00	
Touraine — 274 Delaware Ave.	2.50 - 5.00	5.00 - 7.00	7.50	10.00-13.00
*Worth — 200 Main St.	3.50	5.00	5.50	

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whether you want a double, single, or twin-bed room, and the price range desired. Also indicate a second and third hotel choice, as well as time of arrival and departure. All advance reservations will be verified.

Baltimore - Washington Branch

The meeting at the Electrodeposition Section of the *National Bureau of Standards* on February 13 drew a record turnout, with 63 members, wives and guests present. Branch members at the Bureau planned the evening, and made it an exceedingly interesting one. *Dr. Blum* sounded a note of welcome and gave a preview of the evening's tour. *Abner Brenner* showed his movie on adhesion testing by the nodule method and later showed the equipment used in the procedure; he also demonstrated electroless nickel plating. *Dwight Couch* explained the unusual properties of plated nickel-phosphorous and cobalt-phosphorus coatings and had various samples on display. *Mr. Couch* showed the technique of preparing standards for Magne-gages and the use of these instrument in measuring plate thicknesses. *Victor Zentner* exhibited electroformed nickel foils and tubes. *John Young* showed the pilot plant installation for internal chromium plating of gun barrels. *Vernon Lamb* explained about the use of special gun barrel gages and also showed examples of unusual plating work done in the Bureau job shop. Other Branch worthies at the Bureau, including *Seymour Senderoff*, *Al Pommer* and *Asaf Benderly*, served as guides and answered questions.

The only business taken up at this meeting was the election of officers, with the following voted to serve for the year beginning April 1, 1951:

President *Vernon Lamb*
Vice-President *George E. Best*
Secretary *Vincent J. Hughes, Jr.*
Treasurer *Victor Zentner*
Librarian *Asaf A. Benderly*

Milwaukee Branch Annual Meeting

The annual meeting of the Milwaukee Branch of the A.E.S. will be held on April 28, 1951 at the Schroeder Hotel, Milwaukee. The educational session will begin promptly at 2 P.M. A social evening has been arranged including banquet and entertainment starting at 7 P.M.

In view of the critical times the meeting will be devoted to the subject

of "Finishing for Defense". This will include the preparation and processing of metals in accordance with the requirements of the Armed Services. The meeting will also concern the finishing of civilian materials under the existing conditions. The speakers who will address the group are authorities in the field of metal finishing and are well qualified to present factual data of tremendous importance to everyone.

Technical Program

Dr. Wm. Blum, Chief Electrodeposition Section, Bureau of Standards, Washington, D. C. "The Effect of War on the Electroplating Industry."

Myron B. Diggin, Technical Director, Hanson-Van Winkle-Munning Co., Matawan, N. J. "Plating to Meet Today's Conditions."

Carroll O. Hutchinson, Technical Service Director of Nubian Division, Glidden Company, Chicago, Ill. "Organic Finishes for the Armed Forces."

Tickets at \$6.50 per person may be obtained from R. J. Steuernagel, 2370 No. 32nd St., Milwaukee, Wis.

Rochester Branch

The February meeting of the Rochester Branch of the A.E.S. was held at the Rochester Institute of Technology, with 34 members present.

The speaker of the evening was Mr. C. Heamon Castle, of the Roto-Finish Co., who talked and showed movies on the Roto-Finish methods of barrel finishing.

At this meeting the Branch also considered the resolution offered by the Boston Branch on the subject of dues for the A.E.S.

Boston Branch

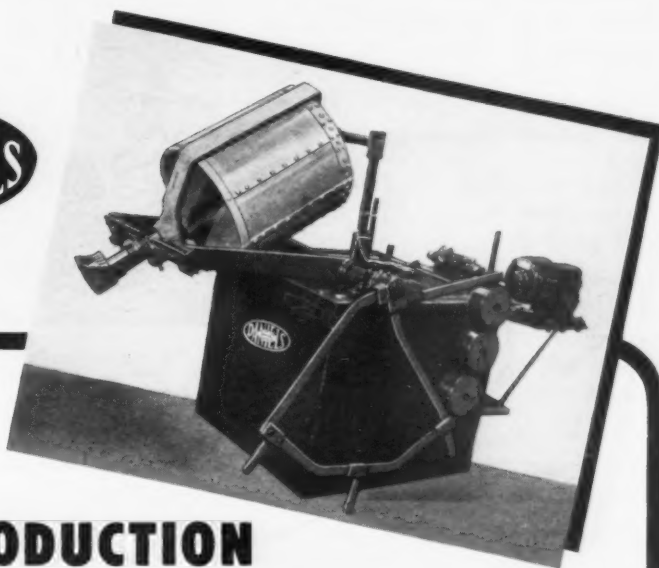
Annual Educational Session and Banquet

The Boston branch will hold its 15th Annual Educational Session and Banquet at the Statler Hotel, Boston, on April 7th. The technical session will feature talks by Herb Head, of Briggs Mfg. Co., Detroit; Myron Diggin, of H-V-W-M Co., Matawan, N. J.; and Dr. Jesse Stareck, of United Chromium Research Labs., Detroit.

The evening's affair will feature entertainment, awards, and dancing till the wee hours. A ladies program, under the direction of Ann Love, is also scheduled.

Tickets are \$7.50 each, and may be obtained from Dr. George Swift, 53 Galen St., Watertown, Mass. Joseph

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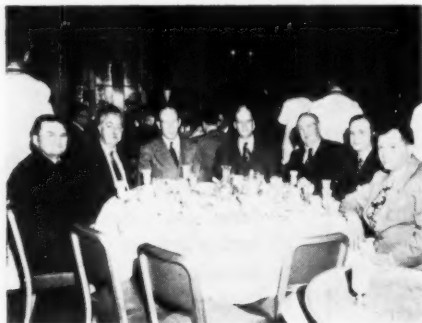
Sullivan, of the MacDermid Co., is chairman for the annual event.

Chicago Branch Holds Annual Banquet

On January 27th the Chicago Branch, largest in the A.E.S., held its annual party at the Stevens Hotel.

The educational program in the afternoon was directed by the Branch Librarian, Mr. J. M. Andrus, and the speakers and their subjects were as follows:

Mr. C. F. Nixon, Ternstedt Div., General Motors Corp.—“Polishing and Buffing.”



Speakers L-R: Dr. Foster D. Snell, Cleve Nixon, and Dr. Cloyd Snavelly pictured with Branch Librarian Andrus.



At the head table during the evening banquet were (l-r) Dr. J. H. Monaweck, Pres. of Chicago Branch; Dr. Foster D. Snell, speaker; Dr. Cloyd Snavelly, speaker; Dr. George Swift, Third V.P. of A.E.S.; Frank MacStoker, Second V.P. of the A.E.S.; Cleve Nixon, speaker and First V.P. of A.E.S.; William Neal, Pres. of A.E.S.

Dr. Foster D. Snell, Foster D. Snell, Inc.—“Emulsion - Solvent - Alkaline Cleaning.”

Dr. Cloyd C. Snavelly, Battelle Memorial Institute—“Pickling and Bright Dipping.”

Earlier in the morning a meeting of the 1952 Convention Committee was held wherein the committee members met with the National officers of the Society to discuss some of the plans for the 1952 convention and industrial exposition which is to be held in Chicago.

At 7 o'clock in the evening the dinner and entertainment in the Grand Ball Room of the Stevens Hotel was attended by 1,100 members and guests of the Chicago Branch.

All of those in attendance agreed that this year's party, from the standpoint of not only the interesting educational program but also from the enjoyment received from the excellent dinner, unsurpassed entertainment and good fellowship, was the finest annual banquet yet sponsored by the Chicago Branch.

New England Regional Meeting

The 12th Annual New England Regional Meeting of the A.E.S. will be held on Saturday, April 28th, at the Hotel Taft, New Haven, Conn.

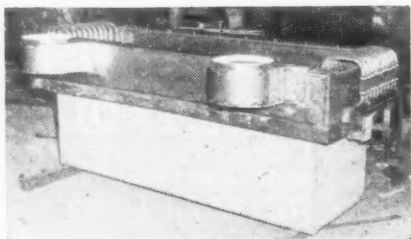
The technical session will start at 2:00 P.M., and will feature the following speakers:

W. D. Starr, The Lea Mfg. Co.—“N.P.A. Regulations Affecting Plating.”

F. A. Lowenheim, Metal & Thermit Corp.—“Plating of Tin - Zinc Alloys.”

A. D. Squittero, Hanson-Van Winkle-Munning Co.—“Iron Plating.”

Harry Sanders, Enthone, Inc.—“Spe-



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cification. Finishing of Aluminum."

The Banquet, starting at 7:00 P.M., will feature a floor show and dancing. Tickets may be obtained from E. V. Collins, Box 127 Bantam, Conn.

New York Branch Annual Banquet

The 1951 annual educational session and banquet of the New York Branch was held at the Hotel New Yorker on Feb. 17th, with an afternoon technical session on "Substitute Fin-

ishes", followed by a banquet, entertainment, and party in the evening.

Opening speaker at the afternoon session was *Sig Bart*, of Bart Laboratories, Belleville, N. J., who gave a very enlightening and interesting talk on electroforming and its applications to the production of military items. He also showed some outstanding examples of the work done by his company. *Alfred Douty*, of the American Chemical Paint Co., Ambler, Pa., talked on the properties and applications for phosphate coatings on zinc, aluminum,

and steel. As this is a very important topic to metal finishers at the present time, his talk was very well received, and he was subjected to a lot of questions by the audience. Following this talk, *Dr. Walter Meyer*, of Enthone, Inc., New Haven, Conn. gave a comprehensive description of oxide coatings for metals and chromate treatments on aluminum and zinc. *Dr. Gardner Foulke*, of H-VW-M Co., Matawan, N. J. concluded the symposium with a discussion of protective treatments for magnesium alloys.

Speakers at the technical session during the New York Branch Annual Meeting



Sig Bart
Bart Laboratories

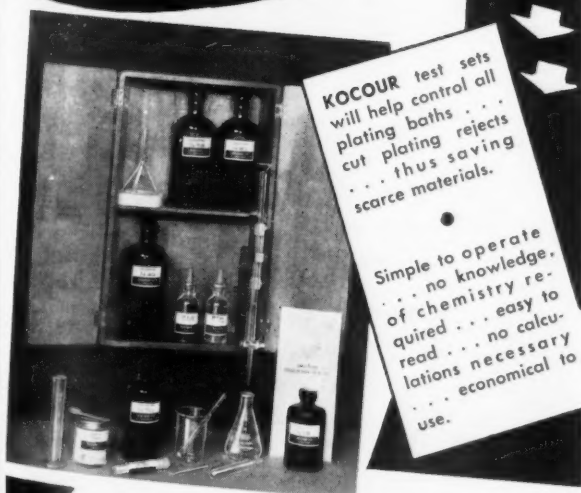


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The evenings banquet and entertainment, which crowded the Grand Ball Room of the New Yorker Hotel to capacity, was a fitting and enjoyable climax to this very successful affair. Angelo Amatore and his committee deserve a round of applause for a job well done.

Cincinnati Branch

Thirty-three Cincinnati Branch members and guests were present for the February meeting, preceded as usual by a fine dinner. Announcement was made of the change in date and place of the 38th Annual Convention and members were asked to volunteer to serve as delegates and alternates at Buffalo.

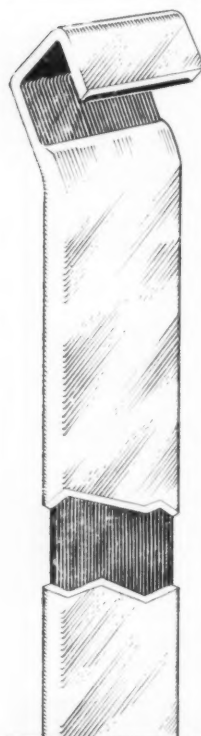
The Branch members were advised of the death of Mr. Frank Nordman during the past month. A letter of sympathy was sent to Mrs. Nordman.

A preliminary report of the Nominating Committee, consisting of W. P. Albohn, chairman, Raymond A. Barry, and William D. Gordon was submitted. Candidates selected for the office of vice-president include C. C. Clabaugh and R. A. Barry. For the office of librarian the Committee has proposed Carl Truman and Harold F. Smith, and for one vacancy on the board of managers, E. A. Blount. Further nominations may be made at the March meeting, at which time the election of officers will be held.

The resolution submitted to the Executive Board of the A.E.S. by the Boston Branch favoring an amend-

ment to the constitution which would raise dues from \$8.00 to \$10.00 per year was read to the members. This will be discussed further between now and June so that Cincinnati Branch delegates attending the National Convention may be properly instructed as to the desires of the Branch in connection with this amendment.

The speaker for the evening was Mr. W. A. Luce, of The Duriron Co., Dayton, O., who spoke on the subject, "Alloys for Handling Corrosive Plating Solutions." Mr. Luce pointed out that first cost in the purchase of equipment for handling corrosive solutions should not be a matter of primary consideration, because oftentimes more expensive equipment would outlast the cheaper products. He further stated that large companies now employ corrosion specialists to ensure the proper purchase and installation of anti-corrosion equipment. Small companies, however, must depend upon the supplier of chemicals or the supplier of processing equipment. An equipment supplier such as The Duriron Company has available an extensive file of information on how various alloys may be used to control corrosive solutions. Specific examples of various alloys in



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METAL FINISHING, April, 1951

a number of copper plating solutions, several nickel plating solutions, and chromium plated solutions were cited, showing the recommended alloys as well as the amount of corrosion experienced.

Test procedures were discussed and the speaker stressed the fact that for even minor changes in the chemical composition of a solution the equipment supplier should be consulted, because in many cases minor changes hastened the corrosion of certain alloys and dictated the use of another alloy.

A short discussion period followed the presentation of this paper, which was illustrated with slides, after which the members adjourned for refreshments furnished by the *A. T. Wagner Co.*, of Detroit.

Toronto Branch Annual Educational Session

The annual educational session and banquet of the Toronto Branch of the A.E.S. will be held on Saturday, May 12, at the General Brock Hotel, Niagara Falls, Canada. The usual afternoon technical session will be followed in the evening by a banquet, entertainment, and dancing.

Speakers for the afternoon meeting are:

Mr. G. Lux, Oakite Products, Inc.
Dr. H. L. Kellner, Lea Mfg. Co.
A. Benning, Harshaw Chemical Co.

Detroit Branch

The March meeting of the Detroit branch of the AES was held on Friday the 2nd at the Hotel Statler.

The well attended meeting was opened by *Ed Hahn*, and the first order of business was the election of several new members to the Society.

Next, *Wright Wilson*, of Auto City Plating Co., chairman of the nominating committee, presented the slate for the 1951-52 election of officers.

Nominated were:

For President — *Frank Clifton*, General Motors.

For 1st Vice-Pres. — *Herb Head*, Briggs Mfg. Co.

For 2nd Vice-Pres. — *Les Borchert*, Houdaille-Hershey Corp.

For Librarian — *Fred Wagner*, Wagner Bros.

For Sec'y-Treas. — *Joe Gurski*, Ford Motor Co.

For Board of Managers — *Frank Watt*, F. B. Stevens, Inc.

For Delegate — *Cleve Nixon*, General Motors; *Herb Head*, Briggs Mfg. Co.; *Walter Pinner*, Houdaille-Hershey Corp.

For Alternate — *Ed. Hahn*, Lyon, Inc.; *Dick Saltonstall*, Udylyte Corp.; *Fred Wagner*, Wagner Bros.

Ballots will be mailed to all members and are to be counted by the tellers before the April meeting. Members of the Tellers Committee are *Henry DeWitt*, United Chromium, Inc.; *Michael Borushko*, Harding Mfg. Co.; *John Hunt*, Wagner Bros.; *Paul Meinschein*, Metal Mouldings Corp. and *Ed Finnie*, Lyon, Inc.

Les Borchert, Educational Chairman, presented *Maurice Caldwell*, of Doehler-Jarvis, Grand Rapids, who prefaced the showing of the movie with a short talk. The movie, a complete picture of the planning, engineering, manufacture and finishing of die castings, was presented through the courtesy of Doehler-Jarvis Corp.

The main speaker of the evening was *Dr. Frederick A. Lowenheim*, Research Chemist of the *Metal & Thermit Corp.*, Rahway, N. J. His talk, "Tin-Zinc Alloy Plating," covered this phase of

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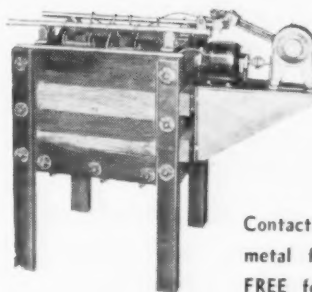
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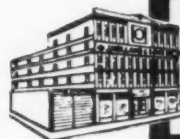
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metal finishing very thoroughly and proved of great interest to the platers present.

Chicago Branch

At the March meeting 50 members were present for dinner with 105 members and guests in attendance at the regular meeting. One of the highlights of the evening was the annual election of officers. The newly elected officers are as follows:

President — R. F. Ledford.
1st Vice-President — Clem Petrosius.
2nd Vice-President — Elmer Olson.
Librarian — J. M. Andrus.
Secretary-Treasurer — Paul Glab.
Board of Managers — Dr. J. H. Monaweck, Chairman; Rudy Hatzucha, Harold Faint.
Delegates — Clyde Kelly, J. M. Andrus, Paul Glab.
Alternates — H. A. Gilbertson, Clem Petrosius, Marion Longfield.

Following the election of officers our Librarian, J. M. Andrus, introduced our speaker for the evening, Mr. Ezra Blount, of Cincinnati, O. Mr. Blount's very informative talk outlined numerous methods and their comparative merit for the preparation of mag-

nesium, aluminum, zinc and steel prior to organic finishing. Those who were not familiar with this phase of metal finishing were somewhat amazed at the numerous methods for preparing the various basis metals for organic finishing, and those in attendance who were familiar with this phase of metal finishing had the opportunity of hearing a detailed outline on the various proposed methods.

Los Angeles Branch

Roy B. Lostutter, of Hard Chrome Engineering Co., was unanimously elected president of The Los Angeles Branch at the March 14th meeting in Rodger Young Hall. Lostutter succeeded Richard Wooley, of Modern Plating Co., who was named chairman of the board of managers.

Other new officers are:

First vice-president: Myron Orbaugh, Bone Engineering Co., Glendale, Calif.

Second vice-president: Dick Richardson, Progressive Plating Co., Long Beach, Calif.

Secretary: Stuart Krentel, Spence Electroplating Co., Los Angeles.

Treasurer: Peter Rodgers, Oakite Co.

Librarian: Earl Arnold, L. H. Butcher Co., Los Angeles.

Walter Behlendorf, of Spence Electro-Plating Co., and Ernest Fest, of Tool and Jig Plating Co., were named to serve with Wooley on the Board of managers.

Joseph Burton, proprietor of the Burton Silver Plating Co., Los Angeles, was initiated into membership. Harry Lier, F. Bradford, and William Fargo, whose applications have been approved, were unable to be present in March and their initiation was advanced to the April meeting.

Sergeant-at-arms Larry O'Neill introduced the following visitors:

William Saunders and David Seymour, of the Diversey Co.; Robert Tucker, Douglas Long Beach Company; Joseph Bell, Progressive Plating Co., Long Beach; Willard Heinecke, Ivan Koltrain and Chester Ingsoll, Kwikset Locks, Inc., Anaheim, Calif.; E. Rabago, Renu Plating Co., Los Angeles; Walter Husband, C.&W. Plating Co. and Ted Rolfson, Oakite Co.

The programmed speaker for the educational session was D. N. Eldred who is well known in Southern California for his analytical service to the

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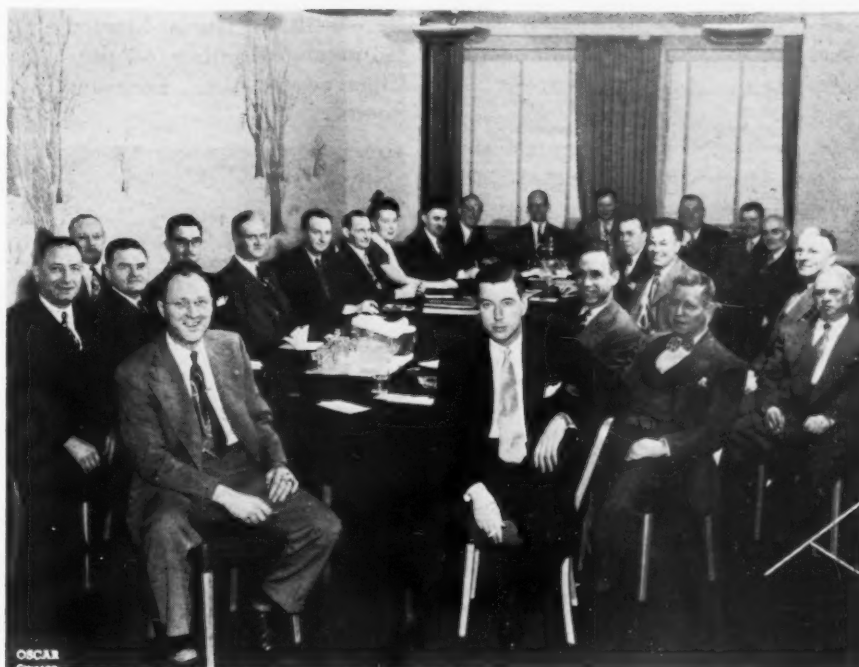
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plating industry. He spoke on "Zinc Plating," a subject he was exceptionally well qualified to discuss, with his background of 25 years association with the Du-Pont Co's. Electro-Chemical Div. and four years as an independent analytical chemist.

The subject was another timely one in the series of talks arranged by Librarian *Morton Schwartz*, who is endeavoring to supply the branch with technical talks on subjects that are currently important in their relation to the defense picture.

Errata

In last month's issue the article on page 108 concerning a meeting of the 1952 A.E.S. Convention Committee meeting in Chicago was accompanied by the wrong photograph. The photo in the March issue was of the Annual meeting of the *National Association of Metal Finishers*, and we herewith present the photograph of the various committee members attending the A.E.S. Convention meeting planning details of the annual convention to be held at the Stevens Hotel, Chicago, next year.



METAL FINISHING ASSOCIATION

The *Metal Finishing Ass'n. of Southern California, Inc.*, is doing a prime job in keeping its job-shop plater mem-

bers advised of what's taking place in the defense setup. In addition to regularly held monthly meetings and occasional special assemblages to deal with emergency problems, the association

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sends out mimeographed bulletins which supply a wealth of information to members.

At its recent general membership meeting, the association adopted a new schedule of dues, graduated according to number of shop employees. The new dues schedule is as follows: 1 to 5 employees, \$5. per month; 6 to 10, \$10.00; 11 to 15, \$15.00; 16 to 20, \$20.00; 21 to 25, \$25.00; 26 to 30, \$30.00; 31 to 50, \$35.00; and 50 and over, \$40.00.

In view of the general interest expressed at the association's last meeting in the various NPA regulations affecting the metal finishing industry, secretary *J. Cranor Richer* announced that special programs have been arranged at which an analysis of NPA regulations as they affect platers was to be featured. A second part of the program was to deal with plant expansion for small business, with a member of the Department of Commerce staff as the speaker.

Dr. William Blum Elected Honorary Member of the Electrodepositors' Technical Society



Dr. William Blum

Dr. William Blum, Chief of the National Bureau of Standards Electrodeposition Section, was recently honored by the *Electrodepositors' Technical Society* of London, by his election as an

honorary member. The Society, consisting of chemists, metallurgists, and other specialists in the electroplating field, has elected only six honorary members in its twenty-six years of existence.

Dr. Blum has been at the Bureau since 1909, and has done research in electrodeposition, including electroplating, electrotyping, and electroforming. He has also contributed to the field of analytical chemistry. He is a member of the American Chemical Society, the American Society for Testing Materials, and an honorary member of the Electrochemical Society, and the American Electroplaters' Society.

Galvanizers Committee to Meet in St. Louis

The Galvanizers Committee, which is sponsored by the *American Zinc Institute*, will hold its twenty-fifth meeting in St. Louis, Missouri, on May 21-22, 1951, according to Chairman *L. C. Flickinger*, of Youngstown Sheet & Tube Co.

W. L. Diehl heads the program committee for the occasion, which will be held at the Hotel Statler.

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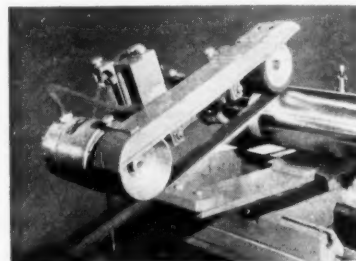
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News from California

By Fred A. Herr



Organized little more than five years ago, *Kwikset Locks, Inc.*, Anaheim, Calif., now produces in excess of five million locks a year. With so tremendous a volume of metal parts production, the firm operates one of the outstanding finishing departments in Southern California. Latest additions to its finishing facilities, *Robert Berry*, plating foreman reports, are a rotary automatic for buffing door knobs and three barrel platers for zinc work on lock parts and door knobs.

Crown City Plating Co. has construction underway on a 50 x 75 foot building as an addition to its metal deposition and painting facilities in Pasadena. *Ray Bray*, foreman, announced that barrel burnishing, zinc and cadmium facilities are to be moved

from the present paint building into the new structure in order to make room in the paint department for more painting facilities. Some additional automatic paint spray units are to be installed to expedite work on a government ordnance job, *Bray* reported.

E. R. Hall, president of *Electrofilm Corp.*, North Hollywood, Calif., announces the appointment of *W. G. Andrews* as executive vice-president and general manager. Andrews was formerly district manager for the *Bastian-Blessing Company*, with which firm he was associated 18 years. In his new post with *Electrofilm*, Andrews will direct all manufacturing, applicator and licenser activities of the *Electrofilm*, S.F.L. and heating processes.

A plating night was featured by *Golden Gate Chapter of the American Society of Testing Engineers* at a recent meeting at which plating techniques were presented by zinc and chrome experts of the *San Francisco area*. *Robert Neuhaus*, of *Pacific Rustproofing Co.*, Oakland, gave a talk on electrogalvanizing. *James Thompkins*, *Industrial Hard Chrome Plating Co.*,

Emeryville, discussed the physical properties of hard chrome plating, plating methods and solutions.

The speakers program at the annual educational session of *Los Angeles Branch of the American Electro-Platers Society* on April 24 will be headed by either *Dr. Walter Meyer*, of the *Enthone Co.*, formerly editor of *Metal Finishing*, or *Dr. R. B. Saltonstall*, of *Udylite Corp.* *Don Bedwell*, chairman of the arrangements committee, announced that plans call for two papers by prominent eastern plating experts and two from western men. Definite is the presentation of a paper on "Possible Uses of Organic Finishes" by *Dr. Gus Klinkenstein*, of the *Maas & Waldstein Co.*

"Radiations from Atomic Explosions" is the subject assigned to a local speaker, in addition to which a fourth technical paper is to be presented. The program calls for morning and afternoon technical sessions, a noon day luncheon, at which plating discussion will be barred, and the annual dinner dance in the evening. Both the technical sessions and the dinner dance will be held at *Rodger Young Auditorium*.



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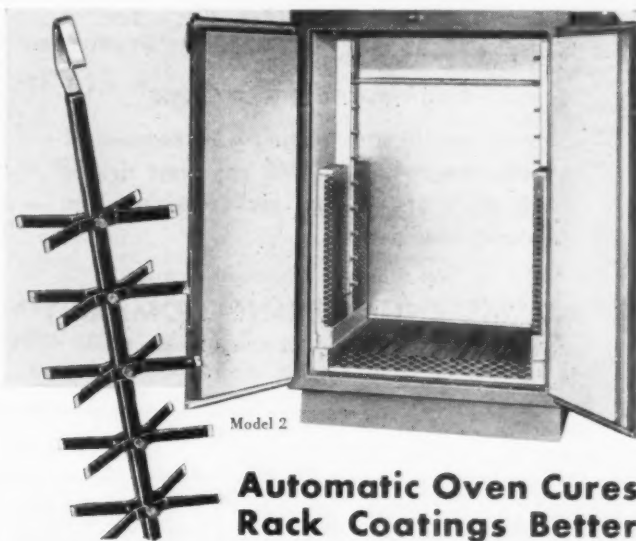
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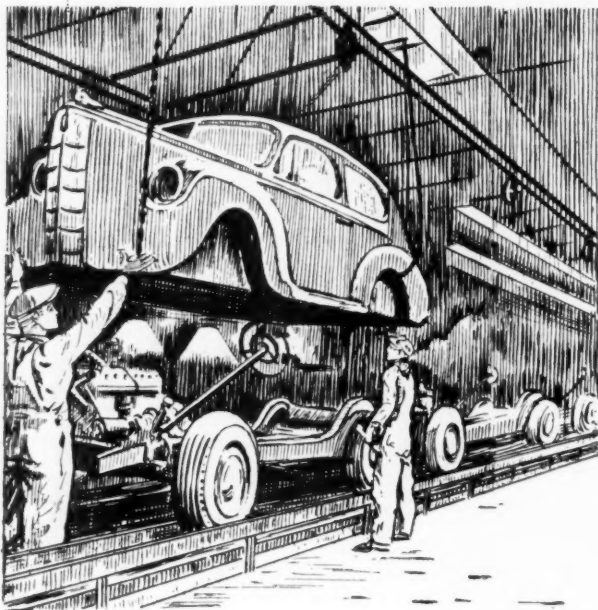
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MOTOR CITY PLATING NEWS



by

Edward F. Fiume

We can't say that there is the cessation of activity in the Detroit plating area that was expected to result as metals became critical and car production was expected to be limited. Because of some easing of previous government controls, car makers are still

booming along at a record pace and platers are keeping right up with them.

It is true that metals are in short supply, particularly nickel, but the reduction in plate requirements by the auto companies is enabling the platers who are allowed to nickel plate to ob-

tain sufficient nickel to just get by.

Substitute finishes for copper, nickel, chrome became almost solid gold investments during the first two months of the year, with zinc plating and conversion coating plus lacquer leading the field, by far, as a substitute for

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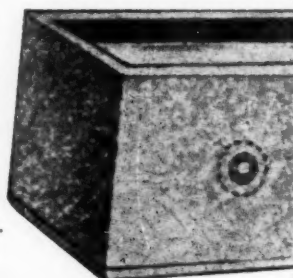


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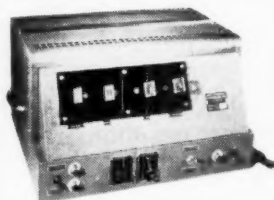
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Mfr. also of pre-fabricated plants for all types of plating.

copper, nickel and chrome plating. Because of the great interest shown in this type of finish by nearly every bright plater, one manufacturer of conversion coatings did as much business in January and February as it did all last year.

Then the relaxation of the copper order sent the car makers into another spin. Now zinc plating and conversions coatings have been shelved, and buffed copper and chromium plating becomes the order of the day. Copper-chrome suits most platers and plating departments best because of the minimum change of equipment required and, in the case of fully automatic set-ups, this feature greatly outweighs the disadvantages of the process.

It looks as though the automobiles are going to retain some form of bright work as long as it is humanly possible. The finishes may not be the best, but they are going to shine.

Herbert W. Marx Joins Sales Force of H-VW-M Co. in Detroit

Announcement is made by the Han-



H. W. Marx

son-Van Winkle-Munning Co., of Matawan, New Jersey, that Herbert W. Marx has joined their sales force.

Mr. Marx attended Michigan State College for three years, majoring in Engineering. His formal education was interrupted by service, for over two years, with the Marine Corps. In 1946, he worked with a large automobile company, in the metallurgical laboratory, performing metallographic ex-

aminations and physical tests. Later, he was in charge of both the experimental and the tool and die heat treating department.

Mr. Marx has completed a training course in the laboratory and plant of H-VW-M and will now serve in the field with headquarters in Detroit.

Harding Manufacturing Co., 10600 Gratiot Ave., Detroit has added a new department to their job plating plant. Harding is now equipped to do industrial silver plating on aircraft bearings, radar equipment and other electronic components. Michael Borushko, technical director, states that their initial equipment consists of a 1,000 gallon unit utilizing a high speed silver plating solution.

Wyandotte Chemicals Corp. has appointed Al Leggin assistant to Robert B. Semple, president. Leggin has been an assistant to the vice-president in charge of research and development. He will head up Washington activities involved in the company's defense participation program.



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Joseph B. Kushner Electroplating School, Dept. MF, Stroudsburg, Pa.

A very interesting bulletin recently published by the above school discusses a very pertinent subject of interest to all plating executives plagued with inefficient production in their plating departments. Copies are available at no charge by writing to the above address.

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**NEW JERSEY
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The Acme Burnishing Co., 22212 Dequindre, Detroit has been appointed as distributor in the Detroit area for the Grav-i-Flo tumbling equipment made by the Grav-i-flo Corp. of Sturgis, Mich.

Victor Bowman, owner of Acme, also announced the addition of *Ernie Losey* and *Dennis Jones* as sales engineers for the company. Losey has had 20 years experience in the metal finishing trade in both sales and practical work. Jones has had 8 years experience in metal finishing and he was formerly process engineer with the Ex-Cello Corp., Detroit.

Acme is prepared to perform production tumbling as an additional service in their own shop.

The Detroit office of *United Chromium, Inc.* has added *Henry DeWitt* to its staff as sales and service engineer.

DeWitt has been in plating for many years, spending 9 years with the *Pyrene Mfg. Co.* in Newark, N. J., where he performed plating control work, worked on development of bright nickel, and functioned as service man for the Pyrene bright nickel process.

Following the Pyrene employment, he worked for the *Kellex Corp.* of N. Y. as Plant Resident Engineer at the Lynch Rd. plant (Detroit) of the Chrysler Corp., which at the time was a vital part of the Atom Bomb program.

He next became a partner in Stone & DeWitt of Van Dyke, Mich. This firm was engaged in the commercial plating of heavy nickel. For the past 3 years, DeWitt has been working on a consulting basis in the plating field.

The Detroit Section of the *American Chemical Society* met at the Rackham Building on Tuesday, February 20th. Guest speaker was *Dr. William H. Summerson*, Chief of the Biochemistry Section, Medical Division, Army Chemical Center, Maryland. He talked on "Biochemistry and Chemical Warfare."

A highly qualified speaker in this field, Summerson received his Ph.D. degree in biochemistry from Cornell in 1937 and subsequently served as associate professor of biochemistry at Cornell University Medical College in New York City. He assumed his present position with the Army Chemical Center in 1947.

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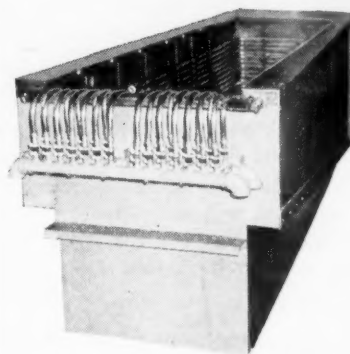


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